

***United States Court of Appeals
for the
District of Columbia Circuit***



**TRANSCRIPT OF
RECORD**

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FOR MR. JUSTICE BREWER

TRANSCRIPT OF RECORD

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United States Court of Appeals for the District of Columbia

APRIL TERM, 1935

No. 6492

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GASOLINE PRODUCTS COMPANY, INC., A CORPORATION, ORGANIZED UNDER THE LAWS OF THE STATE OF DELAWARE, AND HAVING OFFICES AT 11 COMMERCE ST., NEWARK, NEW JERSEY, APPELLANT,

vs.

CONWAY P. COE, COMMISSIONER OF PATENTS.

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF
COLUMBIA.

FILED JUNE 3, 1935.

PRINTED JULY 24, 1935.

United States Court of Appeals for the District of Columbia

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United States Court of Appeals for the District of Columbia

No. 6492.

GASOLINE PRODUCTS COMPANY, INC., &c., Appellant,

vs.

CONWAY P. COE, Commissioner of Patents.

a Supreme Court of the District of Columbia.

In Equity.

No. 54857.

GASOLINE PRODUCTS COMPANY, INC., a Corporation, Organized Under the Laws of the State of Delaware, and Having Offices at 11 Commerce St., Newark, New Jersey, Appellant,

vs.

THOMAS E. ROBERTSON, Commissioner of Patents and/or his Successors in Office, Appellee.

UNITED STATES OF AMERICA,
District of Columbia, ss:

Be it remembered, That in the Supreme Court of the District of Columbia, at the City of Washington, in said District, at the times hereinafter mentioned, the following papers were filed and proceedings had in the above-entitled cause, to wit:

1 In the Supreme Court of the District of Columbia.

In Equity.

No. 54857.

GASOLINE PRODUCTS COMPANY, INC., a Corporation, Organized Under the Laws of the State of Delaware, and Having Offices at 11 Commerce St., Newark, New Jersey, Plaintiff,

vs.

THOMAS E. ROBERTSON, Commissioner of Patents and/or His Successors in Office, Defendant.

Bill to Enforce Issuance of Letters Patent.

Filed September 24, 1932.

To the Honorable, the Judges of the Supreme Court of the District of Columbia in Chancery Sitting:

The Gasoline Products Company, a Corporation organized under the laws of the State of Delaware, and having offices at 11 Commerce Street in the City of Newark, County of Essex, and State of New Jersey, brings this bill against Thomas E. Robertson, Commissioner of Patents and/or his successors in office, said Commissioner of Patents being an inhabitant of the District of Columbia, jurisdiction depending upon a right to relief by suit in equity under Section 4915 of the Revised Statutes (Sec. 63 of Title 35 of the Code of Laws of the United States of America) as amended, and avers:

1. That the Gasoline Products Company is a Corporation organized under the laws of the State of Delaware and has offices in the City of Newark, County of Essex, and State of New Jersey and that the said Commissioner of Patents is, as such, an inhabitant of the District of Columbia;

2. On information and belief, John C. Black, then a resident of Destrehan, in the Parish of St. Charles, and State of Louisiana, before the 6th day of November, 1922, believed himself to be and was the first, sole and original inventor of an improvement in Heating Coil for Cracking Hydrocarbon Oils, and on November 6, 1922, he

applied to the Commissioner of Patents, in due form of law, for a United States patent thereon. The invention of John C. Black was new, useful, not known or used by others in this country before his invention thereof, not patented or described in any printed publication anywhere before his invention, or more than two years before his application aforesaid, not in public use or on sale in this country for more than two years before his application, not patented in any foreign country by him or his legal representatives on an application filed more than one year before his said application in this country, and not abandoned;

3. On information and belief, on November 6, 1922, John C. Black, being the inventor as aforesaid, made application to the Commissioner of Patents for Letters Patent of the United States for his said invention, in due form of law, and therein did particularly point out and distinctly claim the art, method, process, composition and product constituting his invention or discovery, and that said application was given Serial No. 599,403 by the Commissioner of Patents;

4. On information and belief, said John C. Black duly prosecuted his aforesaid application and claims before the said Commissioner of Patents, and in the course of such prosecution clearly defined, delimited and pointed out in the claims thereof his invention aforesaid, as will more fully appear by a duly certified copy of said application and the proceedings thereon ready here in Court to be produced and profert whereof is hereby made;

5. On information and belief, claims 13, 14, 15 and 16 of said application were repeatedly and erroneously rejected upon the proceedings thereunder before the Examiner, which rejection was erroneously made final; that thereupon appeal was taken by the said John C. Black to the Board of Appeals, and claims 13, 14, 15 and 16, together with proposed claims 17 and 18 were presented for consideration by the said Board; and, the said Board, having heard the same, on the 14th day of March 1932, erroneously affirmed the decision of the Examiner rejecting claims 13, 14, 15 and 16 and erroneously failed to consider and allow proposed claims 17 and 18, and that no appeal from said decision has been taken to the Court of Customs and Patent Appeals, all of which will more fully appear by a duly certified copy of the said application and

of the proceedings thereon in the Patent Office of the United States, ready here in Court to be introduced and profert whereof is hereby made;

6. That said application of John C. Black was assigned by written assignment recorded in the United States Patent Office to your Orator who now owns it and all right and title under it. Said assignment has been recorded in the United States Patent Office;

7. On information and belief, the Commissioner of Patents has refused and still refuses to grant Letters Patent upon the aforesaid application of John C. Black for the invention embraced in the rejected claims thereof; and, in said claims 17 and 18; that plaintiff is lawfully entitled thereto; and that plaintiff is the sole owner of all the right, title and interest in and to the said invention and in and under the said application and any patent issued thereon;

Wherefore, plaintiff brings this bill under and in accordance with the provisions of the statute in such case made and provided, and respectfully prays your Honors:

(1) To adjudge and decree that plaintiff, the Gasoline Products Company, is entitled, according to law, to receive Letters Patent of the United States for the aforesaid invention of John C. Black, as specified and particularly pointed out and distinctly claimed in his application hereinbefore referred to, including claims 13, 14, 15, 16, 17 and 18;

(2) That the Commissioner of Patents be directed and authorized to issue such patent;

(3) For such other and further relief as equity may require and as your Honors deem proper, and

4. That a *subpœna ad respondendum*, directed to the Honorable Thomas E. Robertson, Commissioner of Patents of the United States, be issued out of and under the seal of this Honorable Court, requiring him to appear and answer under this Bill of Complaint and abide the further order of this Court.

GASOLINE PRODUCTS COMPANY, INC.,
By HARRY H. SEMMES.

NEWTON A. BURGESS,
Of Counsel.

STATE OF NEW JERSEY,
County of Essex, ss:

William F. Moore, being duly sworn, deposes and says that he is Vice-President of the Gasoline Products Company, Inc., the above-named plaintiff; that he has read the foregoing Bill of Complaint and knows the contents thereof; that the same is true of his own knowledge and belief except as to matters therein stated to be alleged on information and belief, and as to those matters he believes it to be true; that plaintiff is a Corporation, and affiant makes this affidavit and verification for it on its behalf and is duly authorized so to do.

WM. F. MOORE.

5 Sworn to before me this 22nd day of September,
1932.

[SEAL.]

DOROTHY M. COOPER,
Notary Public of New Jersey.

Commission expires Jan. 17, 1937.

Motion to Amend Bill to Insert Copies of Claims.

Filed October 12, 1932.

* * * * *

To the Honorable, the Judges of the Supreme Court of the
District of Columbia in Chancery Sitting:

The Gasoline Products Company, complainant in the above entitled cause, hereby prays leave that it may amend its Bill by adding thereto a copy of the rejected claims 13 to 16 inclusive of the application of Black, referred to therein, as well as proposed claims 17 and 18 which were submitted to the Board of Appeals but not passed upon by that tribunal.

HARRY H. SEMMES,
Solicitor for Plaintiff.

NEWTON A. BURGESS,
Of Counsel.

I consent to the granting of the Motion.

T. A. HOSTETLER,
Solicitor for Defendant.

This Motion is granted this 12 day of October, 1932. Let the amendment be entered.

ALFRED A. WHEAT,
Chief Justice.

Amendment to the Bill.

* * * * *

To the Honorable, the Judges of the Supreme Court of the District of Columbia in Chancery Sitting:

The Gasoline Products Company, complainant in the above entitled cause, hereby amends its Bill of Complaint therein as follows, leave of Court having been obtained the — day of October, 1932.

1. On page 3 of the Bill after the paragraph designated 7, insert the following:

8. That the rejected claims aforesaid read as follows:

13. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron and chromium alloy, said chromium in the alloy being in such proportions as to substantially prevent the corrosive action of sulphur.

14. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron chromium nickel alloy, said alloy being in such constituent proportions as to substantially prevent the corrosive action of sulphur.

15. An apparatus for cracking hydrocarbons comprising a furnace, a cracking coil positioned within said furnace, said coil being formed of material comprising an alloy of iron and chromium substantially resistant to the corrosive action of sulphur and means in said furnace for supplying products of combustion thereto.

16. An apparatus for cracking hydrocarbons comprising a furnace, a plurality of tubes in said furnace through which the oil to be cracked is passed under pressure, said tubes being formed of an alloy of iron chromium and nickel,

substantially resistant to the action of sulphur under the conditions of cracking, and means for passing hot products of combustion over said tubes to crack the oil therein.

Proposed claims 17 and 18 submitted to the Board of Appeals, but not passed upon them, read as follows:

7 17. In the art of converting higher boiling hydrocarbon oil into lower boiling hydrocarbon oil, the improvement which comprises heating said oil to a cracking temperature in a metallic coil composed of an alloy of chromium and iron, said coil being substantially resistant to the action of sulphur.

18. In the art of converting higher boiling hydrocarbon oil into lower boiling hydrocarbon oil, the improvement which comprises heating said oil to a cracking temperature in a metallic coil composed of an alloy of chromium, nickel and iron, said coil being substantially resistant to the action of sulphur.

HARRY H. SEMMES,
Solicitor for Plaintiff.

NEWTON A. BURGESS,
Of Counsel.

DISTRICT OF COLUMBIA, ss:

Harry H. Semmes, being duly sworn, deposes and says that he is Solicitor for the Gasoline Products Company, the above named plaintiff; that he has read the foregoing amendment to the Bill of Complaint and knows the contents thereof; that the same is true of his own knowledge and belief.

HARRY H. SEMMES.

Sworn to and subscribed before me this 11th day of October, 1932.

[SEAL.]

MARY H. SHADRICK,
Notary Public, D. C.

Service and receipt of a copy of the foregoing amendment is hereby acknowledged this 11th day of October, 1932.

T. A. HOSTETLER,
Solicitor for Defendant.

8 *Answer to the Bill of Complaint as Amended.*

Filed October 14, 1932.

* * * * * *

To the Honorable the Judges of the Supreme Court of the District of Columbia:

Thomas E. Robertson, Commissioner of Patents, defendant herein, in answer to the Bill of Complaint alleges on information and belief as follows:

1. He admits the allegations of residence and citizenship of the parties hereto and he admits the jurisdiction under Section 4915 R. S.; 35 U. S. C. A. 63.

2. He has no information as to the allegations of invention and the non-existence of statutory bars except as informed by the Bill and by Application No. 599,403 hereinafter mentioned.

3. He admits that on November 6, 1922, John C. Black filed an application for letters patent in the United States Patent Office, to which application Serial No. 599,403 was given.

4. He admits that the said application was duly prosecuted.

5. He admits that claims 13, 14, 15 and 16 were finally rejected, that appeal was taken to the Board of Appeals, that the Board of Appeals affirmed the decision of the examiner and refused to consider on the merits proposed claims 17 and 18. Defendant denies that the said actions of the Patent Office tribunals were erroneous but on the contrary alleges that the said claims 13, 14, 15 and 16 are unpatentable to plaintiff over the following prior patents:

- 9 Palmer, 1,268,763, June 4, 1918;
Gillespie, 1,306,690, June 17, 1919;
Kelley, 1,365,499, Jan. 11, 1921;
Van Steenbergh, 1,407,339, Feb. 21, 1922;
Metzger, 1,422,878, July 18, 1922;
Black, 1,426,813, Aug. 22, 1922.

The patent to Black, 1,815,428, July 21, 1931, filed October 15, 1922, is also added to the record, particular attention being directed to claims 6 and 7 of said patent. Profert

of copies of all of said patents is hereby made. He admits that no appeal from the said decision of the Board of Appeals has been taken to the United States Court of Customs and Patent Appeals.

6. He admits the allegations of assignment.

7. He admits that the Commissioner of Patents has refused and still refuses to grant letters patent to plaintiff for the said claims and denies that plaintiff is lawfully entitled thereto. He denies that claims 17 and 18 are before the Court for consideration on the merits as it does not appear that claims 17 and 18 have ever been examined by the examiner.

8. He admits that claims 13, 14, 15, and 16, recited in paragraph 8 of "Amendment to the Bill" are copies of the rejected claims and claims 17 and 18 are copies of the proposed claims referred to in the Bill and in this Answer.

Further answering defendant denies that the said claims 13 to 16, inclusive, are patentable to plaintiff as more fully appears from the statement of the examiner and the decision of the Board of Appeals. Copies of said statement and decision will be presented at the hearing.

Further answering defendant denies that proposed claims 17 and 18 are properly before the Court for consideration as they have never been considered on the merits by the examiner in the Patent Office.

10 And further answering defendant denies each and every allegation of the Bill of Complaint not herein specifically and sufficiently denied or admitted, and prays that plaintiff's Bill of Complaint be dismissed.

Wherefore defendant having fully answered the Bill of Complaint denies that plaintiff is entitled to the relief demanded or any part thereof and prays that he be hence dismissed with all costs of the proceedings against the plaintiff as provided in Section 4915 R. S.

THOMAS E. ROBERTSON,
Commissioner of Patents.

T. A. HOSTETLER,
Solicitor of the U. S. Patent Office,
Attorney for Defendant.

DISTRICT OF COLUMBIA,
City of Washington, ss:

I, Thomas E. Robertson, Commissioner of Patents, depose and say that I have read the above answer by me subscribed and know the contents thereof, and that the statements of facts therein made as upon personal knowledge are true, and those made upon information and belief I believe to be true.

THOMAS E. ROBERTSON,
Commissioner of Patents.

Subscribed and sworn to before me this 14th day of October, 1932.

[SEAL.]

ALBERT W. KAISER,
Notary Public, D. C.

My Commission expires April 6, 1933.

11 *Order Substituting Defendant.*

Filed December 18, 1933.

* * * * *

Upon consideration of the motion filed by plaintiff herein, it is hereby ordered this 18th day of December, 1933, that the Honorable Conway P. Coe, Commissioner of Patents, be substituted as defendant for the Honorable Thomas E. Robertson, formerly Commissioner of Patents.

F. D. LETTS,
Justice.

Memorandum Opinion.

Filed February 20, 1935.

* * * * *

I agree with the conclusions reached by the tribunals of the Patent Office. The bill will be dismissed with costs.

BAILEY, J.

Findings of Fact and Conclusions of Law.

Filed March 14, 1935.

* * * * *

Findings of Fact.

1. Plaintiff's application discloses and claims apparatus for cracking hydrocarbons in which the cracking coil is composed of an alloy of iron and chromium, and of iron, chromium and nickel to make it resistant to sulphur corrosion in hydrocarbon oil cracking.

2. The patent to Palmer, 1,268,763, discloses apparatus for making gas from bituminous coal, the retort of the apparatus being formed of ni-chrome steel to make it resistant to oxidation.

12 3. The patent to Metzger, 1,422,878, discloses a retort formed of iron coated with an alloy containing chromium and nickel to make the retort resistant to the corrosive or oxidizing action of the retort or furnace gases.

4. The patent to Kelley, 1,365,499, discloses a process for surface treating a metal with chromium to form a surface that is resistant to corrosion and oxidation.

5. The patent to Van Steenbergh, 1,407,339, discloses apparatus for cracking mineral oil in which apparatus the tubular preheating coil 41^a (Fig. 5) is made of the well-known alloy of chromium and nickel commonly used as an electrical heating element.

6. The patent to Black, 1,426,813, discloses a process and apparatus for the production of low boiling point hydrocarbons in which apparatus cracking coils are employed.

Conclusions of Law.

1. The claims are unpatentable over the prior art adduced by defendant.

2. No invention would be involved in making the cracking coils of the Black patent of an alloy of iron and chromium, or of an alloy of iron, chromium and nickel in view of the patents to Kelley, Metzger, Palmer and Van Steenbergh.

3. Plaintiff is not entitled to a decree for the claims and the Bill will be dismissed.

JENNINGS BAILEY,
Justice.

Final Decree.

Filed March 14, 1935.

* * * * *

This cause having come on to be heard and having been tried in open court and argued by counsel for the respective parties upon the pleadings and proofs adduced and submitted to the Court,

It is adjudged, ordered and decreed this 14th day of March, 1935, that the Bill of Complaint in this case be, and the same hereby is dismissed with costs against the plaintiff.

JENNINGS BAILEY,
Justice.

From the foregoing decree the plaintiff, Gasoline Products Company, Inc., in open court on the date named above, note an appeal to the United States Court of Appeals for the District of Columbia, and the Court fixes the cost bond on said appeal in the sum of \$100, or in lieu thereof the sum of \$50 in cash to be deposited with the Clerk of this Court.

JENNINGS BAILEY,
Justice.

Memoranda.

March 15, 1935.—\$50 deposit in lieu of bond on appeal.

April 1, 1935.—Time to file Statement of Evidence extended to and including May 6, 1935.

Assignment of Errors.

Filed April 1, 1935.

* * * * *

Plaintiff, Gasoline Products Company, Inc., specifies the following as its assignment of errors on appeal herein:

That the Supreme Court of the District of Columbia erred:

1. In dismissing the bill of complaint.
2. In holding that the claims are unpatentable over the prior art adduced by defendant.
3. In holding that no invention would be involved in making the cracking coils of the Black patent of an alloy of iron and chromium or of an alloy of iron, chromium and nickel in view of the patents to Kelley, Metzger, Palmer and Van Steenbergh.
4. In holding that plaintiff is not entitled to a decree for the claims prayed for.
5. In not entering a decree that plaintiff, Gasoline Products Company, Inc., is entitled to a patent for the invention of said John C. Black, as specified and particularly pointed out and distinctly claimed in his application Serial No. 599,403, including claims 13, 14, 15 and 16.
6. In not directing and authorizing the Commissioner of Patents to issue such patent containing said claims.

Wherefore, and for divers other errors in the record of this cause appearing, plaintiff, Gasoline Products Company, Inc., prays that the decree entered herein under date of March 14, 1935, be reversed pursuant to plaintiff's appeal herein, and that plaintiff be granted other and such further relief as to the Court may seem just.

HARRY H. SEMMES,
Solicitor for Plaintiff.

NEWTON A. BURGESS,
Of Counsel.

April 3, 1935.

15 Copy of the above Assignment of Errors by Plaintiff acknowledged this 1st day of April, 1935.

T. A. HOSTETLER,
Per J. R. S.,
Solicitor for Defendant.

Order Making Statement of Evidence Part of Record.

Filed April 29, 1935

* * * * *

Come now the parties hereto by their respective attorneys of record, and thereupon the plaintiff by its attorney

presents to the Court its Statement of Evidence taken at the trial of this cause, and prays that the same be signed and made of record, nunc pro tunc, which is hereby accordingly done.

JENNINGS BAILEY,
Justice.

Designation of Record.

Filed April 1, 1935.

* * * * *

The plaintiff, having perfected an appeal herein to the Court of Appeals, hereby requests that the Clerk of the Supreme Court of the District of Columbia prepare the transcript of record on appeal, including the following:

- (1) Bill of Complaint.
- (2) Motion to Amend Bill of Complaint.
- (3) Amendment to Bill of Complaint.
- (4) Answer to Bill of Complaint.
- (5) Order Substituting Defendant.
- (6) Memorandum opinion.
- (7) Findings of Fact and Conclusions of Law.
- (8) Final Decree, Including Notation of Appeal and Order Fixing Cost Bond on Appeal.
- 16 (9) Deposit in Lieu of Bond on Appeal.
- (10) Memoranda of Dates of Filing, Submitting and Signing Statement of Evidence, and Orders in Reference Thereto.
- (11) Statement of Evidence Including Exhibits of Plaintiff and Defendant.
- (12) Assignments of Error.
- (13) This Designation.

HARRY H. SEMMES,
Attorney for the Plaintiff.

Service of a copy of the foregoing designation of record accepted this 1st day of April, 1935.

T. A. HOSTETLER.

17 Supreme Court of the District of Columbia.

UNITED STATES OF COLUMBIA,
District of Columbia, ss:

I, Frank E. Cunningham, Clerk of the Supreme Court of the District of Columbia, hereby certify the foregoing pages numbered from 1 to 16, both inclusive, to be a true and correct transcript of the record according to directions of counsel herein filed, copy of which is made part of this transcript, in cause No. 54857 in Equity, wherein Gasoline Products Company, Inc., &c. is Plaintiff and Thomas E. Robertson, Commissioner of Patents and/or his successors in office is Defendant, as the same remains upon the files and of record in said Court.

In testimony whereof, I hereunto subscribe my name and affix the seal of said Court, at the City of Washington, in said District, this 24th day of May, 1935.

[Seal Supreme Court of the District of Columbia.]

FRANK E. CUNNINGHAM,
Clerk.

18 In the Supreme Court of the District of Columbia.

Equity Division No. 1.

No. 54,857.

GASOLINE PRODUCTS COMPANY, INC., Plaintiff,

vs.

UNITED STATES COMMISSIONER OF PATENTS, Defendant.

Washington, D. C., Thursday, December 13, 1934.

Pursuant to notice theretofore given all known interested parties, the above-entitled cause came on for hearing in the Supreme Court of the District of Columbia, Equity Division No. 1, at ten o'clock a. m., Thursday, December 13, 1934,

Before: Honorable Jennings Bailey, Associate Justice of the Supreme Court of the District of Columbia, there being

Present:

Newton A. Burgess, Esquire, and Messrs. Semmes and Semmes, by S. Warwick Keegin, Esquire, on behalf of the plaintiff; and

Theodore A. Hostetler, Esquire, Solicitor, United States Patent Office, on behalf of the defendant.

Counsel for the respective parties made opening statements to the Court and, on behalf of the plaintiff, Mr. Burgess filed as Plaintiff's Exhibit No. 1 the following:

Certified copy of the Black application consisting of the application as originally filed, the final rejection of the Primary Examiner, the Examiner's statement on appeal, and the decision of the Board of Appeals.

Thereupon

19 **Enslo S. Dixon** was called as a witness for and on behalf of the plaintiff, and having been duly sworn by the Clerk of the Court, assumed the witness stand and, upon examination, testified as follows:

Direct examination.

By Mr. Burgess:

My full name is Enslo S. Dixon and I reside at Port Arthur, Texas. I am employed by The Texas Company.

Briefly, my educational training was as follows:

I graduated from high school, in Boston, in 1903; completed a course in mechanical engineering in Lowell Institute in 1913; entered Boston Tech, taking metallurgical chemistry looking toward a degree in metallurgy.

In 1917 I entered the Service in a Coast Artillery camp in Virginia and was there approximately two years, mostly at school all the time; I did not go to France.

I have been employed by the following companies since I finished my school work:

In 1919 I entered the employ of the American Steel Wire Company, a subsidiary of the United States Steel Corporation. My employment there was as metallurgical chemist. In 1923 I entered the employ of The Texas Company at Port Arthur, as a metallurgist in connection with their research laboratory, and have been there to the present date.

Generally and briefly, my duties and work since I have

been with The Texas Company were as follows: The first few years I was connected with the Research Laboratory, the Research Chief Chemist being my immediate superior.

This work lasted for six years.

20 During the last five and a half years I have been under the direction of the Chief Engineer, my work being a part of the engineering work.

In combination with metallurgical work, I have charge of what is known as the Test and Records Department which is, to a certain extent, an engineering laboratory. For example, one man handles investigations of packings, pump equipment, and another handles pressure still equipment, failures—by “pressure still”, I mean such things as are involved in a cracking tube. He is assigned to that job completely, the methods of cleaning, the inspection of tubes and what not.

Another man handles exchanger condenser tube work, keeping proper records, securing proper alloys; we have a paint chemist assigned to painting production by various means; we have a group of men who inspect tanks, storage tanks, with respect to tank equipment, safety devices and what not, and another man who handles instruments, various theoretical problems, and so forth.

The cracking tubes were made of carbon steel when I went with The Texas Company in 1923.

The investigation of the problem of cracking tube corrosion was my prime job for the first few years with The Texas Company; the first year it was practically all that I did.

Briefly, some of the high lights of my experience in that regard were: I entered the employ of The Texas Company in 1923 and, early in 1924, a reaction chamber of a cracking unit exploded, killing a number of men, absolutely wrecking the battery, and severely burning the two adjacent batteries.

21 The Texas Company had been conscious of the need of an investigation of corrosion, and that is why I was hired. Much more so were the inspection activities after such a serious disaster in which men were killed.

I spent weeks, in company with others, internally inspecting various pressure still vessels in order to determine the

cause for failure and means to safely inspect the remaining units.

For many years, although I did not have the role of Chief Inspector, I and one more man were referred to as the last word on equipment failure. Even at the present time I and my organization have the final consulting activities in what metal shall be used and whether tubes shall be removed. The responsibility is ours.

I heard of the Black invention in 1924.

The average life of a carbon steel cracking tube at Port Arthur around the time I went there and made this investigation, ranged from a year and a half to two years, and that is still the rate at the present time.

The chief cause of failure of the carbon tubes was sulphur corrosion. This sulphur corrosion manifested itself by the tubes becoming thinned down to such a point that, operating under temperature and pressure, they would swell and sometimes burst wide open, causing danger to life and a money loss.

The sulphur corrosion of steel tubes is a non-uniform corrosion; it was what we called "spotty corrosion".

The effect of the knowledge of the existence of this sulphur corrosion upon the operators of these cracking units is that the morale is decidedly to a disadvantage as far as operating the plant goes. If a unit is known to have thin tubes, men are very loath to risk their lives. They can not work as calmly or safely as they can if they know their equipment is safe.

The rate of corrosion from these sulphur compounds in steel cracking tubes is approximately one quarter of an inch a year. I mean a quarter of an inch through the side wall of the tube; it depends on its location, the location of the tube, and the cracking coil temperature at which the oil is run, the kind of oil that is run.

As a result of my investigation of this tube failure, I learned that the general attitude of the industry toward corrosion and cracking tube equipment, in 1923 and 1924, was that the corrosion was due to acidic constituents in the oil, either mineral acid or organic acid; most of the thought was that it was organic acid corrosion.

During my investigation for the Texas Company on this problem, I found that there was not any chromium alloy

metal used for corrosion prevention in or around the cracking units.

I had occasion to read reports to the company dealing with that subject around that time. In 1921 there was a report issued by W. C. Lauer, who was the chemist detailed to cracking and steel practices, in which he definitely states that the cause of corrosion in cracking steel units was due to acids and not due to sulphides. He makes that statement.

Based upon such a finding, the metals that would be suggested to remedy that trouble would be acid-resisting metals and acid-resisting metals were used. They
23 were principally copper and nickel alloys; they were used for still blocks, pump rods, valves and equipment of that nature in 1923 and 1924.

I first heard of the invention of Mr. Black in 1924.

To my knowledge, the first chromium alloy cracking coil or tube installed by The Texas Company was in February, 1925. I made this installation. It was of one tube. This tube lasted two years. It showed no corrosion from within, no scaling from without, or oxidation from without. It was straight; it did not sag; it did not swell; it did not bend up in seams; it was a perfectly good tube.

A battery adjacent caught fire and in the process of fighting the fire a stream of water was played on to this tube, which was a hard tube, and the tube cracked and was then removed. The adjacent tube that caused the fire was made of carbon steel.

I measured the thickness of the chromium alloy coil after its removal from the unit. That was the way that I determined that there was no corrosion.

Based upon my experience with chromium alloy tubes since that time, my opinion as to the life of that first tube is that if it had not met with this water accident, the tube would have lasted indefinitely, ten or fifteen years, maybe more.

I have installed chromium alloy cracking tubes for The Texas Company since that time. In June, 1926, twenty tubes were installed as a further source of tests from the first one. They lasted two years and were removed from service, because of changes in construction. None had failed. They showed no measurable corrosion; no scaling; no swelling.

24 They were used continuously and put in a location where they were fired hard from the bottom row of horizontal preheating, and were shown no consideration.

Chromium steel alloy cracking tubes have been used extensively by The Texas Company since the first two experimental trials. Eighty per cent of the tubes used since 1928, 1929 have been such alloy tubes; that is, at Port Arthur. At San Antonio, El Paso, California—eighty per cent is a conservative figure of alloy tubes being used.

Even today where cracking does not take place and temperatures are low, it is customary to use carbon steel tubes; that is assuming the corrosive stock is not there, the stock is not so corrosive.

In some plants alloy steel tubes are used practically throughout heater and outside lines. It is true that in all of the cracking units where the sulphur corrosion problem is present the chromium steel alloys are used exclusively in the cracking area.

There again it depends on the grade of stock carried. I mean, a corrosive refinery would call for one answer and a non-corrosive refinery would call for another answer.

I have found from my experience that the chromium alloy tubes possess a great many advantages over the carbon steel as material for cracking tubes. I would like to read the list. There are so many advantages.

The corrosion rate is much lower;

The scale rate is much lower;

The strength is much higher;

The ability to swell prior to rupture is very marked:

25 The ability to stand higher temperature without failure is important;

The tendency toward sagging is less and, therefore, less necessity exists for intermediate supports;

They will operate with a thicker coke formation without failure;

The tendency to burst wide open suddenly is much less than with carbon steel;

The wear resulting from cleaning the tubes with the metallic tube cleaner is less in view of the toughness of the chromium alloy tubes; because of this toughness there is less erosion from the gas and oil;

The wasting away of tubes from erosion, that is, the rush of oil through the tubes, is less with chromium alloy than with carbon steel;

We can use a less amount of metal in the chromium tubes than in the carbon steel for the same service; this would result in a thinner wall for the tube, which, in turn, would avoid internal stresses which we feel have been causes of rupture; thinner walls of tubes afford more efficient heat transfer;

There is less danger with chromium alloy tubes by direct flame impingement in case fire gets out of control; and less trouble with chromium alloy tubes in putting on return bends after cleaning because of the smaller amount of bending of the chromium alloy tubes during operation;

Since there are fewer renewals of chromium alloy tubes, there is less labor necessary because the tubes last longer.

Now, each of these advantages that I have enumerated, is a real substantial advantage from a practical
26 standpoint, and are so recognized in such conferences as I sit in.

The most prevalent danger to life and equipment in connection with oil cracking prior to the adoption of the chromium alloy tubes was tube failures. Some of the sources of danger from that angle are:

The tube thins down from corrosion, sometimes rapidly, while it is still operating under pressure and temperature and with a higher through-put rate under pressure as the tube becomes hot its strength is decreased and, being thin from corrosion, it bursts open.

This presents a hazard to life and a loss of money from property.

Since the pump is charging the oil through the tube, it is necessary to cut down the charge, stop it, but this can not be done right away. Much oil passes through the rupture and, of course, ignites. The battery may be enveloped in flames and sometimes it is impossible for an operator to shut off the proper valves, and the fire continues. Frequently it is attended with loss of life. This is particularly true of outside lines. Outside lines are much more dangerous, much more of a hazard, than tubes in the furnace. By "outside lines" I mean those outside the cracking furnace, such as a line going from the preheater. It is really a part of the heater coil; your pump discharge allowing circulating of the hot oil into the preheater; vapor lines always.

That outside line is a part of the cracking system.

At Port Arthur, where I was located, fires as a result of tube failures, prior to the adoption of the chromium alloy tubes, were very frequent. I would say that once a
27 month would be very conservative; sometimes more often.

Since the chromium alloy tubes have been installed, tube failures are a rare occurrence; they are almost inexcusable. The alloy does not suffer spotty corrosion; it corrodes slowly enough that it can be graded; the operator can know what to run his temperature and pressure.

I have read over and am familiar with the disclosure of the Black application, Serial Number 599,403, involved in this case.

I have studied Palmer patent No. 1,268,763, which is Exhibit "A" in this case.

Palmer does not disclose anything tending to show that a chromium steel alloy or a chromium nickel steel alloy is resistant to sulphur compounds.

Palmer uses the alloy of his patent for a heat resistant metal to be fired externally and to be resistant to corrosion as present from oxidizing gases or to scale as it is commonly called.

He also uses it as is shown on Page 2, Line 80, because it is pervious to the passage therethrough of strongly oxidizing external gases, heating medium, and since it can be penetrated by an oxidizing gas he finds that the carbide pick-up from the inside, which is wholly detrimental to the steel on the inside, is great reduced.

That property which Palmer emphasizes would be entirely unsuitable in a cracking tube.

There is no similarity between the problem of preventing an attack on metal from air oxidation and carbide-forming gases as distinguished from the effect on metal of sulphur compounds in oil cracking.

28 Palmer uses this alloy for oxidation resisting, or for an oxidation resistant to hot gases and because of its ability to be partially pervious to the passage therethrough of strongly oxidized and external gases, whereas Black uses his alloy for resistance to sulphur corrosion.

Now, beginning on Page 2, Line 56, and down to Page 2, Line 105, Palmer points out that the mere application of the high temperature of 1100 degrees C. would cause his alloy to become brittle unless he had, as he states, a surface at least partially pervious to gases.

Now, assuming that brittleness would be brought about by the high temperature, there is nothing in oil cracking to offset that tendency as there is in Palmer's disclosure.

The question of "pick-up" of carbon on the inside of tubes and cracking chambers has been considered.

I recall considerable work done by a manufacturer of pressure vessels in which specimens from stills were examined as frequently as they were available to see if carbon pick-up and change in structure on the inside of a pressure vessel had occurred; that is also the case of carbon steel tubes; examination of carbon pick-up has been made.

There would be no such action take place in oil cracking as explained by Palmer, beginning at Page 2, Line 56, and extending through Line 105.

There would be no harmful sulphur compounds present in carrying out the process of manufacturing natural gas in accordance with the disclosure in the Palmer patent, if a carbon steel retort were used.

There would be no harmful product, no harmful reaction between sulphur and carbon steel in the Palmer re-
29 action process.

In the opinion of the Board of Appeals, indirect reference is made to the Palmer patent as disclosing a use by him analogous to the use by Black in his composition.

There is no analogy whatever between Palmer's use of his composition and Black's use of his composition.

There would be no oxidation problem presented with respect to the interior of the retort in making natural gas substitutes in a device such as that shown in the Palmer patent if that device were made of steel.

He is operating in a reducing atmosphere. That is opposite to oxidation.

I have studied the Gillespie patent No. 1,306,690, which is Exhibit B.

I do not find in it any suggestion that any kind of a tube might be made of the compound structures shown and described in this patent.

There is no reference in the Gillespie patent to the use of the material disclosed therein in the oil cracking industry. He indicates that his material is particularly useful for resistance to fruit juices, pickles, foodstuffs; in cooking, in the canning industry; in dental plates and so forth.

There is no disclosure in the Gillespie patent showing that he in any way appreciated the problem of sulphur corrosion in oil cracking.

In my opinion, the compound structures disclosed by Gillespie would be unsuitable for the making of any kind of a tube that could be used as an oil cracking tube in the oil cracking industry.

30 Because of the forming of a tube, the process of fabricating dualplate into tubes, would be such as to rupture the bond between the alloy and the steel so the process would be unsuitable. There is no intermingling of the crystals between the alloy and carbon steel which would be possible under this method. One would have adhesion and not metallurgical bond.

I have never heard of a tube or seen a tube made of the composition such as that shown and described in the Gillespie patent.

There is no analogy between any use disclosed in Gillespie's patent and that disclosed in Black's.

I refer to the Kelley patent 1,365,499, which is Exhibit C.

Briefly stated, this patent discloses the formation of a coating by means of alloying a metallic powdered chromium with base metal steel. When both are raised to a sufficient temperature the process is similar to calorizing, except in calorizing aluminum is used, whereas in the Kelley process metallic chromium is used.

The outside surface of Kelley's metal would be metallic chromium; underneath the metallic chromium would be an alloy of iron and chromium. That would be of variant percentages as you go deeper in to the base metal itself; iron chromium alloy.

In Line 87, Page 1, Kelley definitely states that the chromium coating would be pervious to hydrocarbon gas. Such porosity would be a disadvantage in oil cracking.

In Line 87, he definitely states that due to his process, carbon will be reduced in his base metal. To overcome and correct this difficulty he definitely states
31 that the treated metal with the coating may be placed in contact with hydrocarbon gas at a proper temperature and carbon pickup of the base metal will be obtained. His statement, starting with Line 87, deals with a very well known practice in metallurgical routine work.

This particular phase of hydrocarbon penetration would be very much undesirable on oil cracking tubes.

We have had a great deal of experience with calorizing processes. The results are as follows:

Calorizing is not a continuous coating. It has skips and holidays and sulphur reactions proceed where the skips and holidays exist; also, cracking tubes must be, of necessity, cleaned with a mechanical cleaner periodically, say every fifteen or thirty days, to remove the coke. That is baked hard on the tubes and you have to take a mechanical cleaner and rub the tubes hard to get it off. You knock it and it is repeated impact, so much so that repeated impact actually takes out of the carbon steel tube pieces of metal of the calorized tubes. This mechanical knocking will remove the coating and allow the base metal to be laid bare and attacked by sulphide corrosion. As a matter of fact, this is a hazard because the operators realizing or feeling, rather, that they have a protected tube are prone to be less careful and watchful of their tubes and that may result in disaster and loss of life.

The coating Kelley discloses would be subject to the same difficulty I have experienced with the calorized tube.

32 The size or the diameter of these cracking coils usually used is three or four inches, outside diameter.

The wall thickness is about four-tenths of an inch; three-tenths to four-tenths, depending on the size of the tube. The inside of a three-inch outside diameter tube would be about two and six-tenths to two and seven-tenths. Two and seven-tenths is the standard I. D. And the wall thickness is about three and a half to four-tenths.

Kelley's problem of putting on such a coating as he talks about here would be increased when he tried to apply it to a tube having two and seven-tenths inches inside diameter as compared with putting it on a plain sheet or inside of a drum or larger surface. It is difficult to process inside of a tube without skips and holidays. The calorizing is hard to do; this would be harder than calorizing because the melting point of aluminum used in calorizing is much lower than the melting point of chromium used in the Kelley process. So, the chances are that a good, continuous coating with aluminum is better than with the chromium.

I also call attention to the fact that Kelley in Line 44 mentions that he adds powdered metallic aluminum, which is similar to the calorizing, the thought being, of course, that this is to aid him in putting on the chromium.

The products of the Kelley process, as disclosed by him, have many commercial uses, such as for furnace parts, boiler tubes, and burner parts. Where this severe knocking is not experienced, they would have use there. It would be a bad thing for an oil cracking tube because of the uncertainties that you have in the tube, and the impossibility of getting a coating that would resist sulphur corrosion. Also this coating, a coating of this sort, 33 would be inherently rough; coke would stick to it, and that would make it necessary to have more frequent cleaning than if it were smooth.

If a cracking tube could be processed one hundred per cent as laid down in this patent, and if the coating were not pervious to hydrocarbon gases, which he says it is, and you had a perfect line of coating, it would have a wide application in the oil cracking industry. If you could conquer the "ifs" you would get along all right.

There is no analogy between the use disclosed by Kelley of his material and the use of his alloy disclosed by Black.

Black presents an alloy for sulphur resistance. Kelley presents an alloy for prevention against gas oxidation. He advocates it for low temperature oxidation and he mentions the salt spray test as a yard-stick to grade the merits of the alloy. No mention is made of sulphur corrosion.

There is no analogy between sulphur corrosion and the corrosion that would result from the salt pray test referred to in the Kelley patent.

I now refer to the Van Steenburgh patent, being Exhibit D, patent No. 1,407,339. Reference is made to the use of chromel, an alloy of nickel and chromium of about eighty per cent nickel and twenty per cent chromium. He uses that as a preheater particularly in reference to ability to raise the temperature of the oil, shown in Figure 5.

The nature of the chromel he refers to there is as an electrical resistance alloy. It has been for many years. It is much used in heat treating furnaces and generally in the steel industry and others. It is used in everyday life in 34 toasters, waffle irons, flat irons and other household appliances.

The Van Steenbergh patent discloses the use of this chromium nickel alloy as the preheater 41-A shown in Fig. 5, and he discloses it for heating elements inside of tubes shown in Fig. 1, the detail of which is shown in Fig.

3. They contain a chromel element on the inside, properly insulated.

Referring to Fig. 3, the small circle with the number 16, is the chromel.

And in his cracking chamber, as shown in Fig. 1, which is the big device there at the left, these chromel heating units do not come in contact with the oil at all. They are inside of a tube; the oil is sprayed on the outside.

The metal on the outside is carbon steel.

The shell of the cracking chamber is also carbon steel. That is so stated in the patent.

The pipe 42 is made of carbon steel.

The primary function of this chromel metal in the tubes 41-A, as shown in Fig. 5 of the Van Steenberg patent, is fundamentally an electrical heating device to raise the temperature of the oil by electric resistance. It has the same function that the chromel wire in the toaster or waffle iron has. In this shell he shows it in Fig. 1 to the left as a heating element.

I find nothing disclosed in this Van Steenberg patent that indicates that he regarded chromium steel alloy or chromium nickel steel alloy as useful as an oil cracking tube.

35 There is no disclosure as to corrosion resistance for its use, for the purpose advocated. The Van Steenberg patent shows the contrary, namely, that he did not appreciate the fact that this metal was resistant to sulphur compounds. He ties into this electric resistance alloy coil; he ties in with carbon steel, as shown at 42. Also his chamber 1 contains tubes electrically heated from within, but they are carbon steel on the outside. Over the carbon steel is splashed the oil. If the oil were corrosive, sufficiently to have 41-A made out of corrosion resistant metal, then the tubes shown in Fig. 1 to the left should also be made out of corrosion-resisting, sulphide-resisting, metal. To be consistent, if he were presenting a corrosion sulphide resistant installation, why, the shell walls should be corrosion-resisting metal also.

For the convenience of the Court, I call attention to Page 2, Line 57, which refers to the walls of the chamber there being made of iron, and to Page 2, Line 95, where he talks about the tubes eleven, the exterior being made of iron; there are other places too. Page 3, Line 10, and perhaps—

yes, Page 2, Line 112; also Line 122, and various other places where reference is made to the fact that these parts are made out of iron.

In my opinion, one skilled in the oil cracking art would not be taught by the disclosure of the Van Steenbergh patent that a chromium steel alloy or a chromium nickel steel alloy would be useful to resist corrosion from sulphur compounds produced in the cracking operation.

The use disclosed in the Van Steenbergh patent of his chromium nickel alloy is not analogous to the use of the chromium steel alloy of Black. Van Steenbergh uses
36 his alloy for electric resistance-heating, whereas Black uses his alloy for resistance to sulphur corrosion in oil cracking.

I know of no instance where an arrangement such as that shown in Fig. 5 of Van Steenbergh has ever been used commercially for the purpose of heating oil as he claims to be able to do. I think it would not be a practical way to heat oil, from the economy standpoint. When you consider the low cost of oil in a refinery, and gas, in a refinery, the use of electric resistance heat for heating oil would be prohibited from a cost standpoint.

As to danger involved in trying to heat oil by this electrical means, such as shown by the Van Steenbergh patent, it is a common practice in oil refineries to be very careful with respect to sparks. For that reason, spark-proof tools are used, enclosed switches are used, and motors. With an arrangement of this sort it would be considered not particularly safe with respect to operation to have electric heater coils where loose connections might occur in the presence of hydrocarbon vapors.

I now refer to the Metzger patent, Exhibit E.

We have had a great deal of experience with methods such as are disclosed in the Metzger patent for putting surface coatings on metal.

Briefly stated, my experience has been as follows:

In January, 1926, we learned of a process similar to this process. I investigated the process and, on my recommendation, The Texas Company purchased equipment to coat metals in a similar manner to this described by Metzger.
37 This process consists of a tool or gun through which a wire of selected composition is passed

through an oxyacetylene flame. The alloy is melted and blown onto the surface with a blast of air forming a coating.

The Texas Company spent upwards of \$10,000 at Port Arthur alone in this endeavor to get this coating.

We coated the inside dome of ten black oil agitators; we coated the inside roof of two run-down tanks; we coated the entire interior of a tank used to store transformer oils; we coated the upper third of a reaction chamber. The results were negative. The coating did not afford the protective coating against acids in the case of the black oil agitators, and against sulphide and other corrosive agents in the case of the run-down tank, and against sulphur in the case of the reaction chamber.

If we found it impossible to put a suitable coating on these large vessels, I have mentioned, it would be impossible with the present equipment to put a coating on the inside of a three-inch or a four-inch tube.

Even if we got a coating on the inside of a three-inch or a four-inch cracking tube as well as we got it on the inside of the larger chambers and vessels, there would be a positive corrosive action going on inside of the cracking tube, because this process makes no metallurgical bond with the base metal, steel; and, since cleaning with mechanical knockers must take place every fifteen or thirty days, the coating would be probably all removed the first time it was cleaned.

Metzger makes no reference whatever in his disclosure to the use of this process on cracking tubes.

38 He makes no reference in his patent to the fact that his coating may be resistant to sulphur compounds.

He does not even mention the use of a process on tubes of any kind. He is referring to a retort.

You have various retorts used in the manufacture of gas. You have various chambers used for heat treatment and processing of steel in which this might be applicable.

In our efforts we used mostly the low melting point metals, such as lead, zinc, aluminum, and so forth.

If we had difficulty with putting a suitable coating on with these low melting point metals, it would be much more difficult with chromium because of the high melting point of the chromium alloy.

I have never heard of any instance where cracking tubes have been made by a process of that such as Metzger is using—chromium.

Products of the process such as Metzger discloses have commercial uses in their own field, principally for protection for steel structures, like bridges, where there was no mechanical cleaning; for decorative purposes; for novelty jobs such as plaster casts coated with bronze and copper; they have a certain field that is their own, but not in the oil cracking field.

The use which Metzger mentions in his patent of his product, is not analogous in any way to that which Black makes of his alloy. He uses his coating for protection against oxidation, exterior sealing in a retort, while Black uses his for protection against sulphur corrosion.

As compared with the cracking coils in use prior to Black,
39 in my opinion, Black produced a new and useful result in making oil cracking tubes.

As compared with the cracking coils in prior use, Black produced a cracking coil having an increase in efficiency. His alloy would stand higher temperatures, be stronger and stay on stream longer and is more efficient; the longer runs are less worrying; there is less worry about corrosion with regard to efficiency of operation.

Black's alloy effected a saving of operation of cracking coils as compared with steel cracking coils. The equipment would stay on stream much longer. These cracking coils of the chromium steel alloys have gone into wide commercial use.

Cracking tubes of the Black composition have a beneficial effect as far as operators are concerned. The effect on morale of operators when equipment is operated with unknown quality of tubes is such as to cause a very tender condition around batteries. Men are nervous, excited, and very much concerned when the equipment is at all doubtful as to its safety. Their lives depend on the condition of the battery operating under temperature and pressure.

Also, in regard to construction forces, with an alloy tube there is much less change of tube because of corrosion, much less tugging, pulling and dragging and rolling in tubes, much less general work; and that is particularly true

of small refineries where the personnel is much more limited than it is at Port Arthur.

In my opinion, cracking tubes of the Black composition have at least five times as long a life as carbon steel tubes; in some cases many more times than five. Five is conservative.

40 The price per pound of steel cracking tube was, approximately, four cents a pound prior to Black's day.

The price of the alloy of the Black composition for cracking tubes would run from ten cents to sixty cents a pound, depending on the alloy used, which, in turn, depends on the location of the heater in which it is placed. The pressure commonly used in oil cracking ranges from four hundred pounds to the square inch to six hundred pounds to the square inch depending on the location in the heater in question; some tubes operate lower, at lower pressure; some at higher pressure than others.

The temperature range is from seven hundred to one thousand and fifty, again depending on the location of the particular tube being considered.

That is the temperature of the oil. The tube temperature runs as high as thirteen hundred Fahrenheit by actual measurement, maybe more.

Briefly, I give some indication as to the loss of time, loss of production, damage to equipment and operators caused by the bursting or cracking of a coil in a furnace when it is in operation. A tube will thin down from corrosion. It is operating under pressure and temperature and will swell and burst open or sometimes burst suddenly open. This is particularly true with respect to hazard from outside lines. In the meantime, the charging pump is operating at full capacity. A large number of barrels of oil are deposited around the unit which, of course, with the oil feeding the flame it takes some time to stop the pump. If the fire is unusually severe, it is impossible to get to the control

valves. A battery burns and maybe the adjacent
41 batteries catch on fire. This is expensive, and there may be loss of life.

I have photographs showing tubes that have burst in actual experience. Maybe the Court would be interested in looking at those. Photograph No. 1 (indicating a photograph) shows a portion of vapor line operating at four hun-

dred pound pressure and nine hundred degrees temperature, which burst in the Port Arthur refinery unit.

Mr. Burgess: I offer that as "Plaintiff's Exhibit No. 2."

(Photograph in question was marked by the Reporter "Plaintiff's Exhibit No. 2".)

That was a vapor line of carbon steel.

This (indicating a second photograph) is a photograph showing discharge connection from a pump; that portion on the left had been removed and was full thickness and the portion to the right was one-sixteenth of an inch or less. This caused a severe fire.

Mr. Burgess: I will ask that that be marked "Plaintiff's Exhibit No. 3."

(The photograph in question was marked by the Reporter "Plaintiff's Exhibit No. 3.")

Photograph No. 3 represents a section on the left which had corroded, which, compared with the section on the right, which is a new tube, the weight for the same length in the same size tube is dropped from thirty-four pounds to nine pounds.

Mr. Burgess: I offer that as "Plaintiff's Exhibit No. 4."

(The photograph in question was marked by the Reporter "Plaintiff's Exhibit No. 4.")

42 This photograph (indicating another photograph) represents corrosion found in carbon steel tubes. The two tubes shown on the left are approximately one-sixteenth of an inch thick; the third from the left is full size. The tubes on the left were under pressure and temperature.

Mr. Burgess: I ask that that be marked "Plaintiff's Exhibit No. 5."

(The photograph in question was marked by the Reporter "Plaintiff's Exhibit No. 5.")

The metal of which all of these tubes shown in these four photographs were made was carbon steel.

The art began to use tubes in oil cracking in 1915 with the introduction of the Burton Clark installation.

The metal of which the cracking tubes were composed prior to Black's alloy tubes was carbon steel. It was used successfully for that purpose up until Black's day.

I have already referred to the installations made by me for The Texas Company of chromium alloy cracking tubes, those installations lasting over a period of two years. I regard that period of what we might call experimental use for those tubes as a short period for an industry to adopt such a thing as that in its cracking apparatus.

When one considers the danger to property and life and the fact that carbon steel had been known for years, I would say that the large tonnage of alloy tubes introduced into the oil cracking industry in the last seven years showed a very rapid advance in the art of using alloy tubes.

The possible chemical reactions between the hydrocarbon oil in the cracking tubes and the metal of the cracking tubes are complex.

43 When it is considered, the very complex structure of the hydrocarbon molecules, the number of reactions between the oil and the metal of the tube are almost infinite; in fact, very little is known today of the exact structure.

Cross-examination.

By Mr. Hostetler:

Q. Mr. Dixon, does all natural petroleum oil contain sulphur? A. I would say they all contain some sulphur, yes.

Q. Yes. Are there any other corrosive elements in natural petroleum besides sulphur? A. Yes, there are.

Q. Is sulphur found very profusely in soft coal? A. Yes.

Q. If oil would run through a pipe without heat or pressure, would there be any corroding effect? When I say "oil" I mean natural petroleum oil. A. Very little.

Q. Very little? A. Yes.

Q. Is it increased, the corroding effect, increased by heat and pressure? A. Yes.

Q. What is the heating temperature for cracking oil, approximately? A. Eight hundred to nine hundred degrees, or even as high as ten hundred and fifty degrees.

By the Court:

Q. Is that Fahrenheit? A. That is Fahrenheit; depending on the process.

44 By Mr. Hostetler:

Q. In the Palmer patent, at the bottom of Page 2, he gives some of the qualities——

The Court (interposing): Which exhibits?

Mr. Hostetler: Exhibit A.

By Mr. Hostetler:

Q. It gives a table of composition with nickel, chromium and iron. Is that, approximately, the proportions that are usually used in metals of that kind? A. That is—that is, approximately, the proportions used for heat resistant metals.

Q. And the last line, on that page 2, it says:

“Moreover, it corresponds substantially to cast iron in tensile strength, heat conductivity and co-efficient of expansion.”

Is there anything inconsistent in that statement with the qualities that you testified to as to this metal? A. Yes.

Q. Does it increase the tensile strength over carbon steel? I mean the chromium and nickel in the alloy? A. Yes.

Q. The Palmer patent, Exhibit A, as shown in Fig. 2, we have there a retort, narrow, high, long.

In the use of that apparatus as a retort for making natural gas substances, is not soft coal placed on the inside of that retort and then heat by gas or otherwise applied to the outside?

Would that not bring the heat and sulphur gases that exist therein in contact with the surfaces inside and
45 outside of that retort? A. It would bring them in contact with the inside of the retort, yes.

Q. Turning now to Exhibit D, the Van Steenberg patent, Fig. 5: That is stated to be a preheater and, on Page 4, in describing Fig. 5, we find at Line 16 this:

“The pipe sections 41 (a) may be composed of chromel, an alloy of nickel and chromium and well insulated in a well known manner.”

Further down in Line 40, it gives the temperature for heating eight hundred degrees to one thousand degrees Fahrenheit.

Would that temperature be operative to preheat the oil?

A. Yes, it would be operative to preheat the oil.

Q. Turning now to Fig. 1 of the Van Steenberg patent, at the lower right hand corner of that figure I see the word "preheater" which is arranged, as stated in the specification, to be heated by coal or oil fuel.

Does that function or is it intended to function the same way as the preheater in Fig. 5? A. It is used to preheat the oil.

Q. It distinguishes from Fig. 5, though, by using a different heating material, does it not? A. It is distinguished from preheater Fig. 5, by its different method of heating and by a different heating material, yes.

Redirect examination.

By Mr. Burgess:

46 In cross examination I was asked about the presence of sulphur in soft coal. I know that it is customary in purchasing coal for making natural gas to put a limitation on the amount of sulphur that may be present in the coal.

And under the circumstances existing inside the retort, Fig. 2 of the Palmer patent, there would not be presented any question of sulphide corrosion, not even if there were the permissible amount of sulphur in the coal used. That is because the sulphide under the temperature of this retort is so high in temperature and dry that it does not, would not, attack this retort even if it were steel. I might call attention to the fact that processes of this sort customarily used steel stand pipes, for years, without any particular corrosion from sulphur compound and also to the fact that preheaters and tubes in oil cracking and stills fired by gas and oil, which are relatively rich in sulphur, have no corrosion problem on the exterior, where they come in contact with these products of combustion, other than air oxidation due to temperature.

No exception is made with respect to sulphide corrosion from the outside of tubes although sulphur is present.

Now, in reference to the Palmer patent, I was asked on cross examination whether there was anything inconsistent in the statement beginning at Page 2, Line 130, with the qualities that I have attributed to the Black composition and my answer was that there were some inconsistencies. They are as follows:

Palmer is purely a coating job. It is a cast job which would have lower ductility, whereas the tubes of the Black type would be drawn tubes, processed, not cast.

47 The Black tubes have higher tensile strength than cast iron and, therefore, according to this statement at the bottom of Page 2, the Black composition would have qualities not found in the composition given here in the table of Palmer. And if the composition of which the cracking tubes are made had no greater tensile strength than cast iron, they would not be suitable as cracking tubes. This Palmer patent says that its composition is comparable to cast iron and in cracking tubes we look for higher strength than cast iron, higher ductility, a drawn rather than a cast tube.

Mr. Burgess: That is all.

Mr. Hostetler: Nothing more.

Mr. Hostetler: I might, in order to make certain that these patents are in the record, introduce them officially as Defendant's Exhibits.

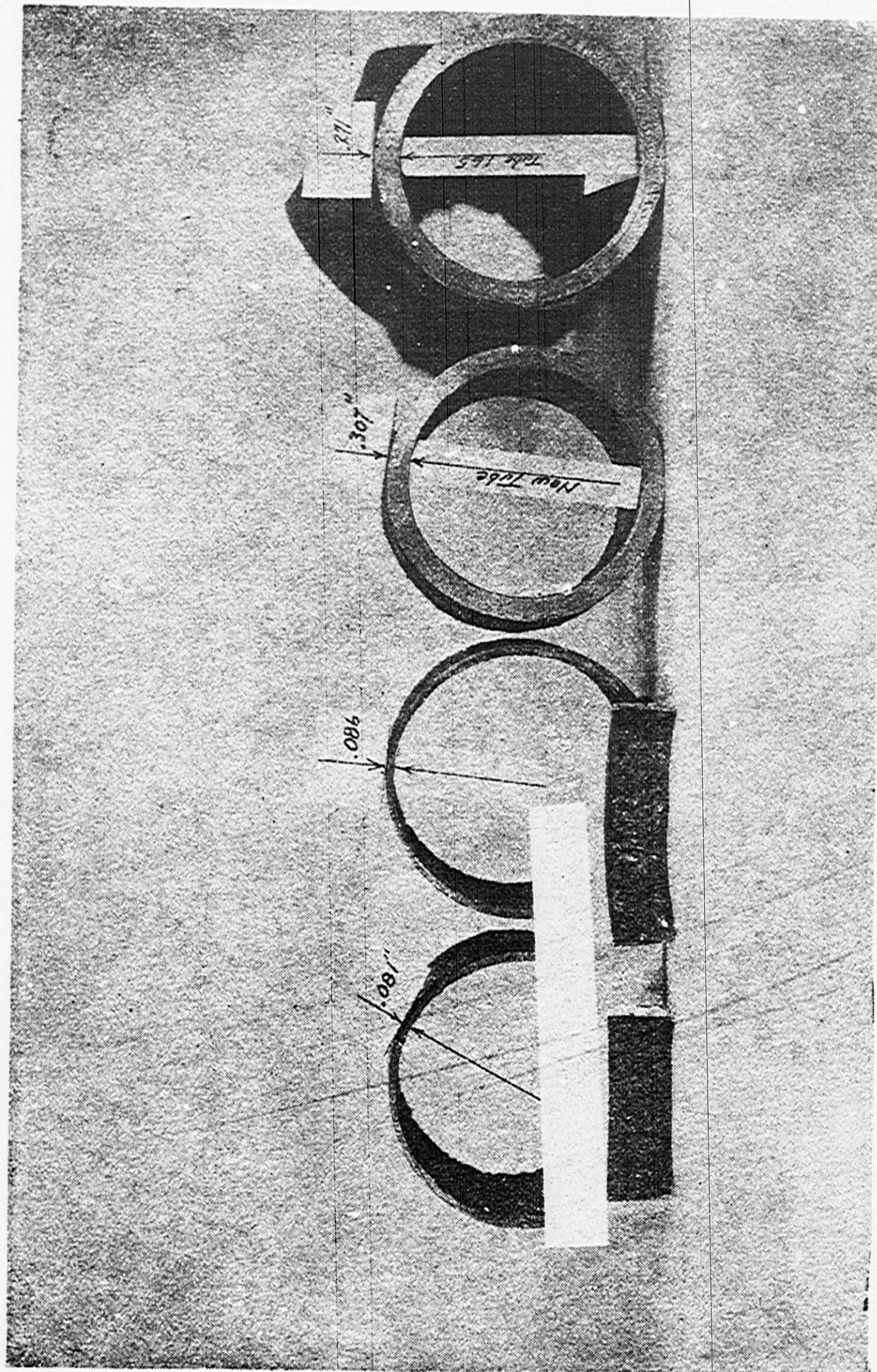
(The patents in question were appropriately marked by the Reporter and placed in the custody of the Court.)

48 Be it further remembered that the foregoing contains the substance of all of the evidence given on the hearing of this cause, and in order that the same may be preserved and made of record this statement of evidence is duly stated, approved and signed, and ordered to be made of record in the above-entitled cause this 29th day of April, 1935.

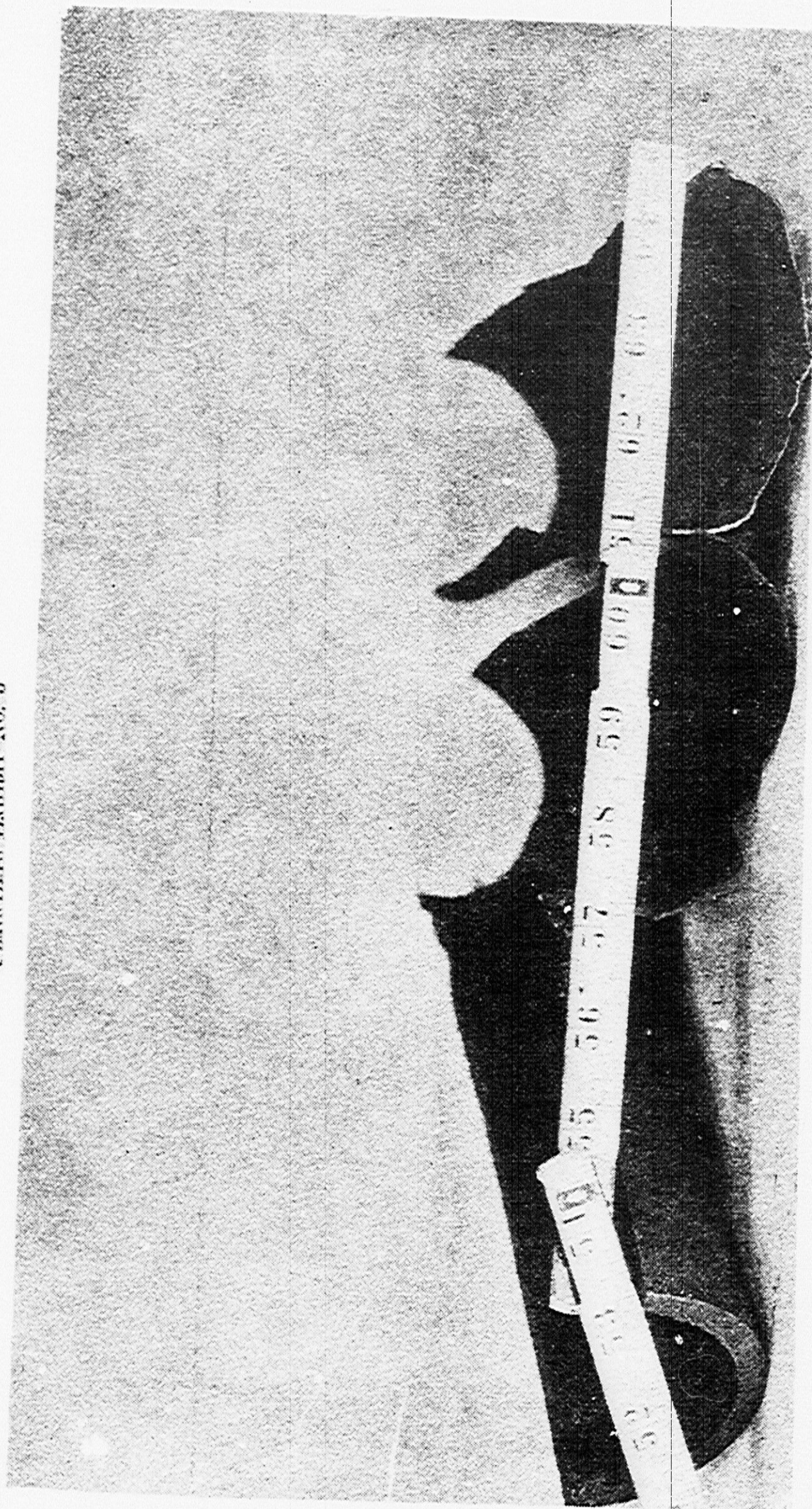
By the Court:

JENNINGS BAILEY,
Justice.

Service of the foregoing statement of evidence is acknowledged this 23rd day of April, 1935, and the attorney

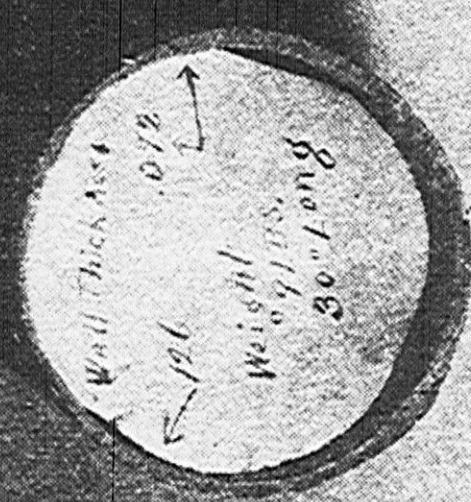


PLANTERS EXHIBIT No. 3



PLAINTIFFS EXHIBIT No. 2





for the defendant consents to the settlement of the said statement as submitted.

T. A. HOSTETLER,
Solicitor for Defendant.

49 [Endorsed:] In the Supreme Court of the District
of Columbia. Equity Division No. 1. Gasoline
Products Company, Inc., Plaintiff, v. United States Com-
missioner of Patents, Defendant. In Equity No. 54857.
Statement of Evidence.

(Here follow 4 photos, folios 50-51, 52-53, 54-55, 56-57.)

58

390.

Department of Commerce, United States Patent Office.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records of this office of Certain Papers, under Section 4915 of the Revised Statutes, in the matter of the Pending Application of John C. Black, Filed November 6, 1922, Serial Number 599,403, Renewed July 7, 1927, for Improvement in Heating Coil for Cracking Hydrocarbon Oils.

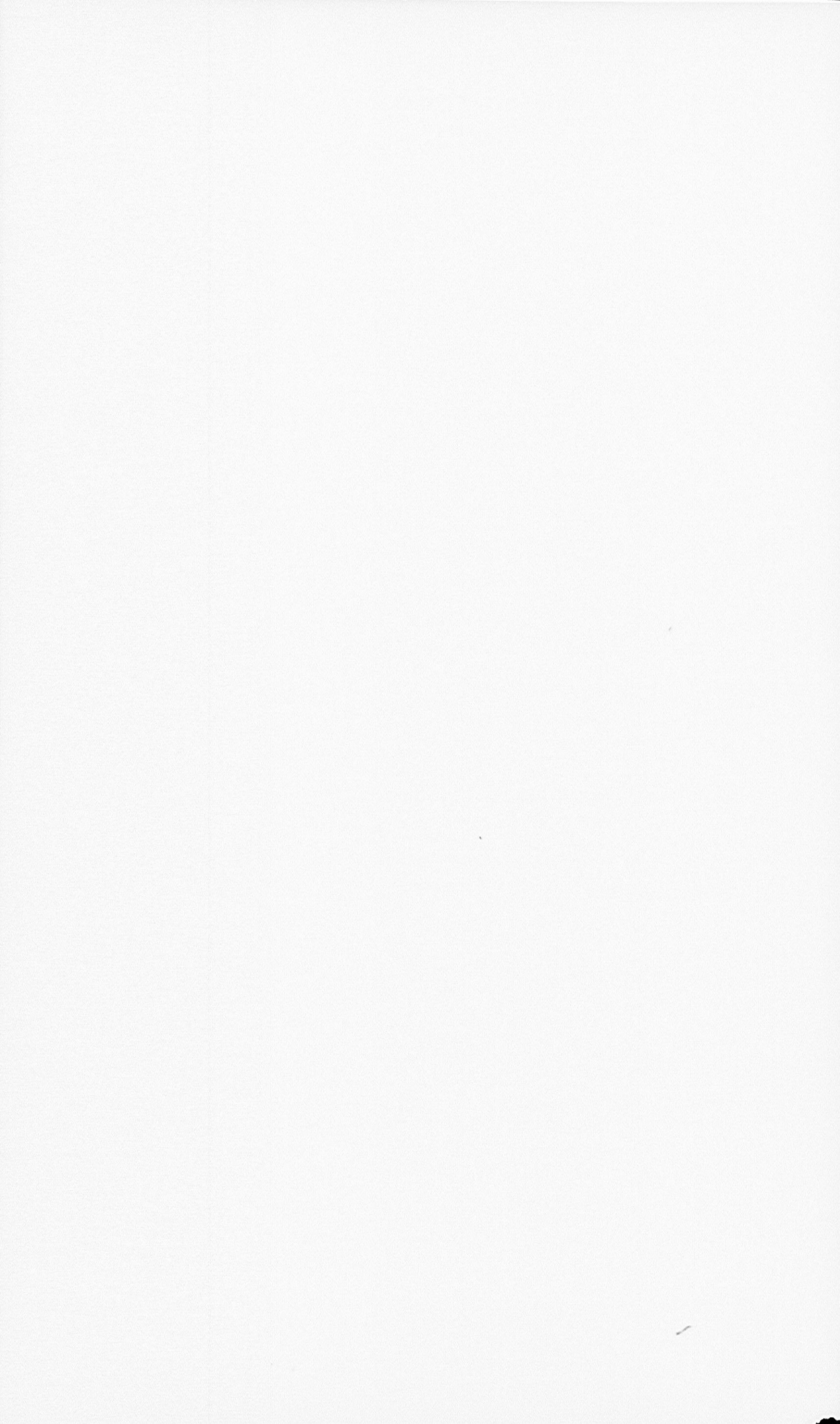
In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this eighth day of November, in the year of our Lord one thousand nine hundred and thirty-four and of the Independence of the United States of America the one hundred and fifty-ninth.

[Seal Patent Office, United States of America.]

CONWAY P. COE,
Commissioner of Patents.

Attest:

D. E. WILSON,
Chief of Division.



PAPER NO. j
NOV 9 1922
DIVISION 31.

RECD
NOV 8 1922
CC-132-1000

P E T I T I O N

TO THE COMMISSIONER OF PATENTS:

see paper #9
Your petitioner, John C. Black, a citizen of the United States, resident of ~~Destrehan, in the Parish of Saint Charles, and State of Louisiana~~ ^{Los Angeles, in the county of Los Angeles, California}, whose Post Office address is ~~Destrehan, Louisiana~~ ^{Box "C" Wilmington, California}, prays that letters patent may be granted to him for a HEATING COIL FOR CRACKING HYDROCARBON OILS, as set forth in the annexed specification.

And he hereby appoints J. T. Newton, whose address is Washington Loan & Trust Company Building, Washington, District of Columbia, and whose Registration Number is _____, his attorney with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to sign his name to the drawings, to receive the Patent, and to transact all business in the Patent Office connected therewith.

Signed at Destrehan, in the Parish of Saint Charles, and State of Louisiana, this 24 day of October 1922.



John C Black

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

paper #9
Be it known that I, John C. Black, a citizen of the United States, residing at ~~Destrehan, in the Parish of Saint Charles, State of Louisiana~~ ^{Los Angeles, California}, have invented a HEATING COIL FOR CRACKING HYDROCARBON OILS, of which the following is a specification:

599403
1

This invention relates to the art of producing low boiling point hydrocarbons from those of high boiling point hydrocarbons and more particularly by the process described in my ^{Patent 1426513} application, Serial No. 344400, in which the hydrocarbons are heated in a coil and maintained while being heated at a pressure sufficient to prevent vaporization of the hydrocarbons and this application for Letters Patent refers particularly to the method of operating and constructing the heating coil in the before mentioned ^{Patent 1426513} application No. 344400.

In the before mentioned ^{Patent 1426513} application, Serial No. 344400, I describe a process wherein I employ temperatures as high as 1000° F and pressures as high as 1000 pounds or more per square inch. To withstand these excessive temperatures and pressures, it is essential to construct the heating elements or coils in a very substantial and safe manner, and furthermore, it is advantageous to so construct the coil that each pipe or tube can be easily opened for inspection and cleaning without dismantling it. It is also advantageous to be able to construct the coils outside of the furnace and insert them in the furnace as a complete coil only requiring connection to the balance of the apparatus to make it operative.

I have discovered that the presence of sulphur in the hydrocarbons, either as free sulphur or as sulphur compounds, will readily attack the steel of the tubes when the coil is in operation under the high pressure and high heat employed in the process. To overcome this difficulty, I prefer to use an alloy steel such as nickel steel or chrome nickel steel, or I may use a tube which has been heat-treated with aluminum wherein a thin coating of aluminum iron or aluminum steel alloy is produced which acts as a protective surface to the tube and prevents to a great extent the destructive action of the sulphur or sulphur compounds.

599403-2

To withstand the high pressure employed in the process and especially so under the high heat employed, I prefer to use a seamless drawn tube in preference to a pipe made by welding, such as the ordinary butt or lap-welded pipe of commerce, as I have found that such pipe will not stand the strains as well as the seamless tubing. However, I do not wish to limit myself in the construction of my coils, as either seamless or welded seam pipe may be employed.

Referring to the drawings:

Figure 1 is a sectional elevation of the coil placed in the furnace.

Figure 2 is a plan view of the coil.

Figure 3 is an end elevation on the line 3-3 of Figure 2.

15 Figure 4 is a sectional view of the return connectors and clean-out blocks.

pc *Fig 5 is a sectional view of the coil clamps.*
Like numbers refer to like parts in the various figures.

The furnace 1 is of brick construction and may have one or more compartments. In the drawing, 1 is shown as a furnace with three compartments, one for combustion space, one for the main coil 2 and one for the economizer coil 3. The furnace is fitted with a stack 4 to carry off the products of combustion; 5 is an oil or gas burner of the ordinary type; 6 is a door to afford access to the coil 2; 7 are the blocks which form the crossovers from tube to tube and 8 are clamps to hold the coil together; 9 are angle blocks for making connections one part with the other; 10 are plugs in the angle blocks and coil blocks to afford means for inspection and cleaning the tubes; 11 is a connecting tube from the outlet of the coil to the digester or carbon catcher described in

patent No. 1426813

pro C
 my application, Serial No. 244406; 12 are the tubes shown in Figures 2 and 4; 13 the threaded connection of the tube and block; 14, 15 and 16 are the three sections that go to make up the clamp 8 shown in Figure 3. *CT*

Invent C'
 It will be noted in Figure 1 that the coil 2 is located entirely within the heating zone of the furnace with only the ingress and egress connections out of the heating zone - this I have found desirable and in some cases necessary to prevent the corrosive action of the sulphur or sulphur compounds in the hydrocarbons being cracked, as I have found by experience that there is a thin coating of carbon deposited upon the inside of the tubes which acts as a protective coating thereon and the sulphur present in the hydrocarbons will not attack the steel either in the tubes or the return connectors. This protective carbon or carbonaceous deposit is only formed in the tubes or return connectors when they are inside the heating zone of the furnace and is due, I believe, to the baking action of the high heat found in the heating zone and to which the coil is subjected. This is a very important feature of my cracking coil, as it adds very materially to the life of the coil. It also has the added feature of the entire coil acting as a heat absorbing element, no portion of which is outside the heating zone.

pro A
 The coil as constructed consists of a plurality of *arranged in layers each tube in one layer being* tubes, ~~connected one to the other by means of steel blocks~~ *to a tube in another layer* bored through in line with the tubes, one side being counter-bored and threaded to receive the threaded end of the tube and the other end of the bored hole is threaded to receive removable *plugs* ~~threaded~~ which act as closures when the coil is in operation, *or* when removed will afford means for inspecting and cleaning

579403-4

the tubes. Lengthwise with the blocks is a bore hole, preferably the size of the inside diameter of the tubes, and in communicating with the two previously described bore holes, the axis of the longitudinal bore hole intersects the axes of the two transverse bore holes; the upper end of the longitudinal bore hole is threaded to receive a threaded plug which has the same function as the two previously described plugs.

The longitudinal bore hole is not bored beyond the point where it makes full communication with the second tube opening, although it could be drilled through and threaded the same as the other end, but nothing would be gained by this and expense would be incurred.

In place of threading or screwing the tubes into the blocks, they may be welded in, the blocks then being only counterbored to receive the tubes and not threaded.

To hold the coils as a unit, I employ a three piece cast iron or steel clamp, usually three in number to each coil, one near each end and one in the middle; the middle portion of the clamp is grooved out with semi-circular grooves to receive the tubing and so spaced as to give the proper spacing of the tubes; the upper and lower portions of the clamp are also grooved out in a similar manner to the middle portion and have extended ends through which pass bolts to fasten the top, bottom and middle sections together, thus securely fastening the various tubes into a single rigid unit.

I prefer to construct the coil in a symmetrical manner as to spacing of the tubes, that is to say any lower tube is equidistant from the two tubes immediately above it, and vice versa, any upper tube is equidistant from the two tubes immediately below it.

Furthermore, the blocks at one end of the coil are inclined uniformly in one direction or the other and at the opposite end of the coil in the reverse direction. By this expedient, tubes placed parallel with the longitudinal axis of the coil will connect opposite blocks, and when all the blocks are so connected, the structure so assembled will form a continuous coil of a single passage with two open ends, one for inlet and the other for outlet connection. This is all clearly shown in the drawing - Figures 2, 3 and 4.

The blocks may be placed vertically instead of inclined, but if this is done, the tubes will not be parallel with the axis of the coil and it might be difficult to insert a cleaning tool into the tube, as it would be sprung out of line a distance equal to the spacing between tube centers. For this reason, I prefer the first described method of construction, but I do not wish to be limited to that type, as the last mentioned construction will be operative.

What I claim as new is:

1. A heating coil for cracking hydrocarbons in the liquid phase comprising a plurality of ^{layers of} tubes with tubular blocks at their ends so connecting the tubes as to form a coil having a continuous single passage therethrough.

2. A heating coil for cracking hydrocarbons in the liquid phase comprising a plurality of ^{layers of} tubes with tubular blocks at their ends so connecting the tubes as to form a coil having a continuous single passage therethrough, and means detachable from the blocks to permit access to the interior of the tubes.)

3. A heating coil for cracking hydrocarbons in the liquid phase comprising a plurality of ^{layers of} tubes with connecting tubular blocks to form a continuous conduit from end to end of the coil, and spacing clamps to hold the tubes in place, to form a symmetrical coil with uniform interstices.

4. A heating coil for cracking hydrocarbons in the liquid phase comprising a plurality of sulphur resisting metallic tubes connected together by means of sulphur resisting metallic tubular blocks to form a coil having a continuous single conduit, said blocks having detachable means for permitting inspection and cleaning of said coil.

5. A heating coil for cracking hydrocarbons comprising a plurality of ^{layers of} seamless metallic tubes connected together by tubular metallic return connectors to form a continuous metallic conduit, said connectors being provided with removable plugs for permitting inspection and cleaning of the coil, and spacing clamps for holding said tubes in symmetrical and rigid assembly as described.

599403-7

6. A hydrocarbon cracking furnace having therein a coil comprising a plurality of sulphur resisting seamless ^{layers of} ~~each couple of tubes one in each layer having~~ tubes together with detachable sulphur resisting return connectors assembled into a continuous conduit to form a coil, said tubes and connectors being placed entirely within the heating zone of the furnace, and tubes on the outside of the furnace leading to and from the coil.

7. A hydrocarbon cracking furnace having therein a coil comprising a plurality of tubes together with detachable return connectors assembled into a continuous conduit to form a coil, said coil being placed entirely within the heating zone of the furnace whereby the coil with its tubes and connectors is rendered sulphur resistant substantially as described.

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In testimony whereof I have signed my name to this specification.

John C. Black

---- oOo ----

O A T H

STATE OF LOUISIANA)
PARISH OF SAINT CHARLES) 33.

JOHN C. BLACK, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Destrehan, Parish of Saint Charles, State of Louisiana; that he verily believes himself to be the original, first and sole inventor of a HEATING COIL FOR CRACKING HYDROCARBON OILS, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns, more than twelve months before this application, or in public use or on sale in the United States for more than two years prior to this application; and that no application for patent on said invention has been filed by him or his legal representatives or assigns in any country foreign to the United States.

John C. Black

Subscribed and sworn to before me this 24 day of October, 1922.

O. H. Sheeton
Notary Public

599403

7

RENEWAL

Serial No 599403 Div. 31
1 Sheet. Sheet

O. G. FIG 4
CLASS 196 SUB CLASS 110

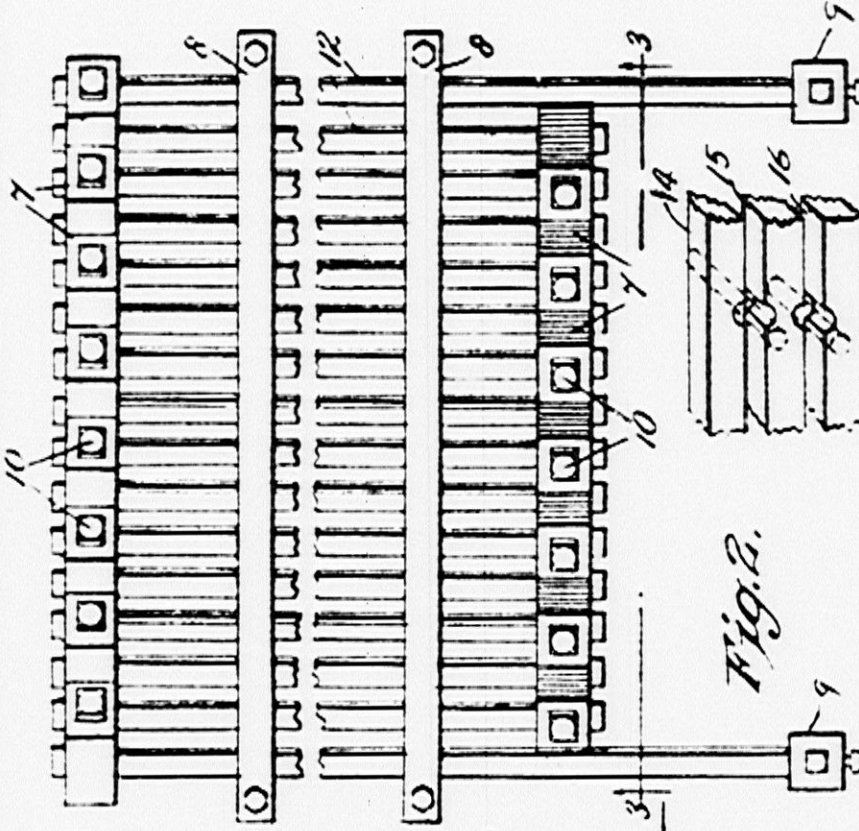
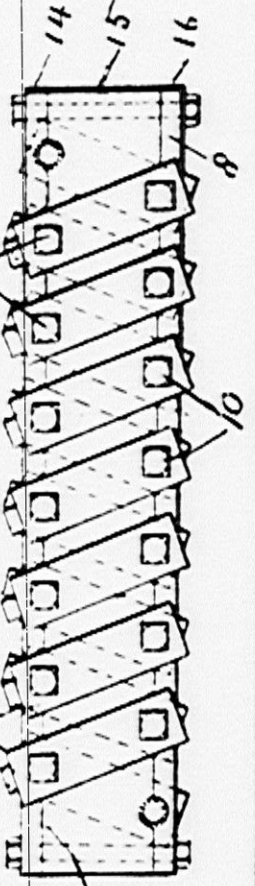


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.



Inventor
John C. Black

by J. S. Newton

Attorney

Div. 31

Room 312

NM-VA

Paper No. 24

Address only
 "The Commissioner of Patents,
 Washington, D. C."
 and not any official by name

DEPARTMENT OF COMMERCE
 UNITED STATES PATENT OFFICE
 WASHINGTON

All communications respecting this
 application should give the serial number,
 date of filing, and name of
 the applicant

Please find below a communication from the EXAMINER in
 charge of this application.

Thomas E. Robertson
 Commissioner of Patents.

MAILED
 FEB 12 1931

O P O 11-11-31

Applicant: John C. Black

Semmes & Semmes,
 600 Investment Bldg.
 Washington, D. C.

Ser. No. 599,403
 Filed Nov. 6, 1922
 For HEATING COIL FOR
 CRACKING HYDROCARBON OILS

Responsive to amendment of June 17, 1930

All the claims are finally rejected on
 the references and for the reasons of record.

M. V. Holmes

Examiner, Div. 31.

599403 2
 44

70

[Stamp:] Mailed Jan. 7, 1932.

Paper No. 29.

NM-VA.

Department of Commerce.

In the United States Patent Office,
Washington.

In re Application of John C. Black. Serial No. 599,403.
Filed Nov. 6, 1922. For: Heating Coil for Cracking
Hydrocarbons.

On Appeal to the Board of Appeals.

Examiner's Statement.

This is an appeal from the final rejection of all the
claims which are as follows:

* * * * *

Claim 13. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron and chromium alloy, said chromium in the alloy being in such proportions as to substantially prevent the corrosive action of sulphur.

Claim 14. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron chromium nickel alloy, said alloy being in such constituent proportions as to substantially prevent the corrosive action of sulphur.

71 Claim 15. An apparatus for cracking hydrocarbons comprising a furnace, a cracking coil positioned within said furnace, said coil being formed of material comprising an alloy of iron and chromium substantially resistant to the corrosive action of sulphur and means in

said furnace for supplying products of combustion thereto.

Claim 16. An apparatus for cracking hydrocarbons comprising a furnace, a plurality of tubes in said furnace through which the oil to be cracked is passed under pressure, said tubes being formed of an alloy of iron chromium and nickel, substantially resistant to the action of sulphur under the conditions of cracking, and means for passing hot products of combustion over said tubes to crack the oil therein.

The references relied upon are:

Black, 1,426,813, Aug. 22, 1922,

Gillespie, 1,306,690, June 17, 1919,

Kelley, 1,365,499, Jan. 11, 1921,

Metzger, 1,422,878, July 18, 1922 (filed Oct. 11, 1917),

Palmer, 1,268,763, June 4, 1918,

Van Steenbergh, 1,407,339, Feb. 21, 1922 (filed Dec. 16, 1920).

The invention relates to the art of cracking high boiling hydrocarbon oil into low boiling constituents and resides in the particular composition of the metallic tubular cracking coil. Applicant makes the tubes of the coil out of an alloy steel such as nickel steel or chrome nickel steel because these materials are resistant to the corrosive action of sulphur and sulphur compounds which are ordinarily present in hydrocarbon oils, and which attack ordinary steel tubes. Applicant's patent 1,426,813 shows tubular cracking coils 5, 11 and 14 made of ordinary steel. It is coils of this nature that applicant proposes to replace with the noted special alloy steel coils.

The patent to Gillespie is for an article of manufacture consisting of a sheet of steel which is coated with a chromium alloy steel. It is disclosed that this alloy steel is incorrodible (lines 9 to 21 of the patented specification).

72 The patent to Kelley is for a surface-alloyed metal in which chromium is alloyed with iron, nickel, molybdenum, or tungsten (page 1 lines 19 and 20). It is disclosed on page 1 at lines 14 and 26 that such alloy is resistant to corrosion.

The patent to Metzger is for a retort which is ordinarily made of iron and whose surfaces come in contact with heating gases which ordinarily contain corrosive substances. In order to protect such iron "to a very great extent if

not entirely against the corrosive action of such gases" (page 1 lines 36 to 38), Metzger coats the exposed surfaces with an alloy of nickel and chromium (page 1 lines 54 to 59 and 83 to 89).

The patent to Palmer is for a water gas apparatus in which the retort 2 and steam superheater coil 7 may be made of ni-chrome steel which is an alloy of nickel and chromium with steel.

The patent to Van Steenbergh is for an oil cracking apparatus in which the tubular superheating coil 41a (Fig. 5) is made of chromel, an alloy of nickel and chromium (page 4 lines 7 to 24).

Claims 5 to 9 call for a cracking coil in a hydrocarbon cracking apparatus. The material of the coil is stated in various degrees of breadth, ranging from "metallic cracking coil substantially resistant to the action of sulphur" in claim 5, "alloy" in claim 6, "alloy of chromium" in claims 7 and 8, and "alloy of chromium and nickel" in claim 9.

Claim 13 specifies that the metallic cracking coil is
73 composed of an iron and chromium alloy while claim

14 specifies that the alloy is iron chromium nickel. Claims 15 and 16 parallel claims 13 and 14 except that they call for the combination of the cracking coil with a furnace and means in said furnace for supplying products of combustion thereto.

All the claims have been rejected on the ground that it is not invention to make the tubular cracking coils of Black 1,426,813 out of non-corrosive metal alloys such as disclosed in each of the patents to Gillespie, Kelley, Metzger, Palmer and Van Steenbergh. All of these patents show that it was known before applicant thought of building cracking coils of the alloys in question that such alloys were non-corrosive to sulphur and sulphur compounds and it is submitted that it is, therefore, not invention to make such coils of said alloys to resist corrosion. Palmer and Van Steenbergh go further in that they build tubular coils of such materials, the latter a coil which is used for cracking hydrocarbon oil.

Claims 15 and 16 appear to be designed to avoid Van Steenbergh because this patentee shows his coil being heated electrically but this is not thought to be an important differentiation since the coil and heater of the modification of Fig. 5 is suggested as a substitute for coil 41 and

heater 40 of Fig. 1 of the patent. In either case the oil is within the coil and the oil is being submitted to conditions under which corrosive action tends to take place so that it makes no difference whether the heating is electrical or in a furnace by means of gases of combustion.

For the reasons set forth, it seems that the final rejection of the claims should be sustained.

Respectfully submitted,

W. N. HOLMES,
Examiner, Div. 31.

[Stamp:] U. S. Patent Office, Board of Appeals.
Mar. 29, 1932. Mailed.

Appeal No. 3286. Paper No. 33.

Appeal No. 3286.
Hearing: March 14, 1932.

AES.

Decision.

In the United States Patent Office.

Before the Board of Appeals.

Ex parte John C. Black.

Application for Patent filed November 6, 1922. Serial No. 599,403. Heating Coil for Cracking Hydrocarbon Oils.

Mr. Donald H. Mace and Messrs. Semmes & Semmes for applicant.

This is an appeal from the action of the primary examiner finally rejecting claims 5-9 and 12-16.

Claim 13 will serve as illustrative of the matter involved.

13. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron and chromium alloy, said chromium in the alloy being in such proportions as to substantially prevent the corrosive action of sulphur.

76 The references relied on by the examiner are:

Palmer, 1,268,763, June 4, 1918;
Gillespie, 1,306,690, June 17, 1919;
Kelley, 1,365,499, Jan. 11, 1921;
Van Steenberg, 1,407,339, Feb. 21, 1922;
Metzger, 1,422,878, July 18, 1922;
Black, 1,426,813, Aug. 22, 1922.

The applicant on page 1 of his brief has withdrawn the appeal as to claims 5-9 inclusive and 12. This leaves only claims 13-16 inclusive for consideration.

The claims are drawn to apparatus for cracking oils and the feature applicant is relying upon for their allowance resides in the specific material of which the metallic cracking coil is formed. This material is defined in claims 13 and 15 as an iron and chromium alloy and in claims 14 and 16 as an iron-chromium-nickel alloy.

The patent to Black discloses the type of apparatus defined in the appealed claims but does not disclose the use of the particular alloy recited in the claims as material from which the cracking coil may be constructed.

The examiner has cited several patents to show that applicant's alloy is old and has been used in various relations. Of these references the patent to Metzger may be selected as representative.

Metzger discloses the use of iron-chromium-nickel alloy for retorts in the manufacture of coal gas, oil gases
77 and in certain processes employed to effect the fixation of atmospheric nitrogen. He states that this material is practically unaffected by or offers substantial resistance to the corrosive or oxidizing action of the gases which are generated in a retort or furnace.

Metzger's use of the alloy is deemed analogous to applicant's use and it is believed that in view of this patent, and the other patents relied upon by the examiner, there would be no invention in the selection of the alloy disclosed therein as a material from which the cracking coil of the Black patent may be manufactured.

The proposed claims 17 and 18 contained on page 2 of the brief have not been considered. See *Ex parte* Moore, 1923 C. D. 13.

The appeal is dismissed as to claims 5-9 inclusive and 12.

The decision of the examiner is affirmed as to claims 13 to 16 inclusive.

M. J. MOORE,
Assistant Commissioner,
EUGENE LANDERS,
Examiner-in-Chief,
P. P. PIERCE,
Examiner-in-Chief,
Board of Appeals.

March 29, 1932.

Endorsed on cover: District of Columbia Supreme Court. No. 6492. Gasoline Products Company, Inc., &c., Appellant, vs. Conway P. Coe, Commissioner of Patents. United States Court of Appeals for the District of Columbia. Filed Jun. 3, 1935. Henry W. Hodges, Clerk.

[Stamp:] United States Court of Appeals for the District of Columbia. Filed Jul. 12, 1935. Henry W. Hodges, Clerk.

Addition to Record Per Stipulation of Counsel.

In the United States Court of Appeals for the District of Columbia.

Equity No. 6492.

GASOLINE PRODUCTS COMPANY, INC.,

vs.

CONWAY P. COE, U. S. Commissioner of Patents.

Stipulation.

It is agreed between counsel for the parties to this cause, the court willing, that soft copies of patents may be bound in the printed record of this case in the Court of Appeals of the District of Columbia. The soft copies of patents which are to be bound in the record are identified as follows:

No. 1,268,763, Palmer,
1,306,690, Gillespie,
1,365,499, Kelley,
1,407,339, Van Steenbergh,
1,422,878, Metzger,
1,426,813, Black.

Respectfully submitted.

R. F. WHITEHEAD,
*Solicitor for the Patent Department
and Counsel for Conway P. Coe,
Commissioner of Patents.*

HARRY H. SEMMES,
Counsel for Gasoline Products Company, Inc.

July 12, 1935.

(6430-C)

C. S. PALMER.
 PROCESS OF AND APPARATUS FOR MAKING NATURAL GAS SUBSTITUTE.
 APPLICATION FILED OCT. 5, 1917.

1,268,763.

Patented June 4, 1918.

Fig. 2

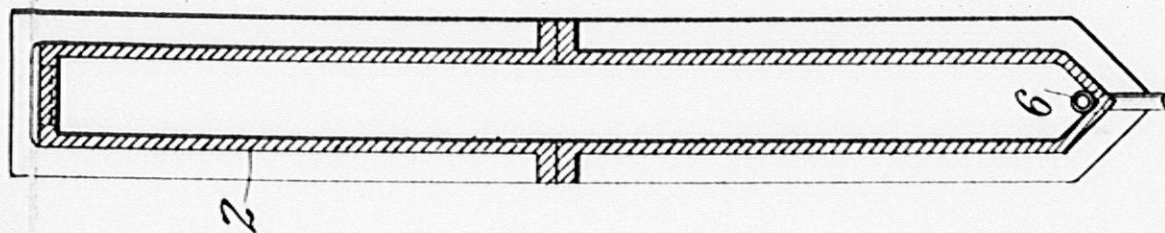
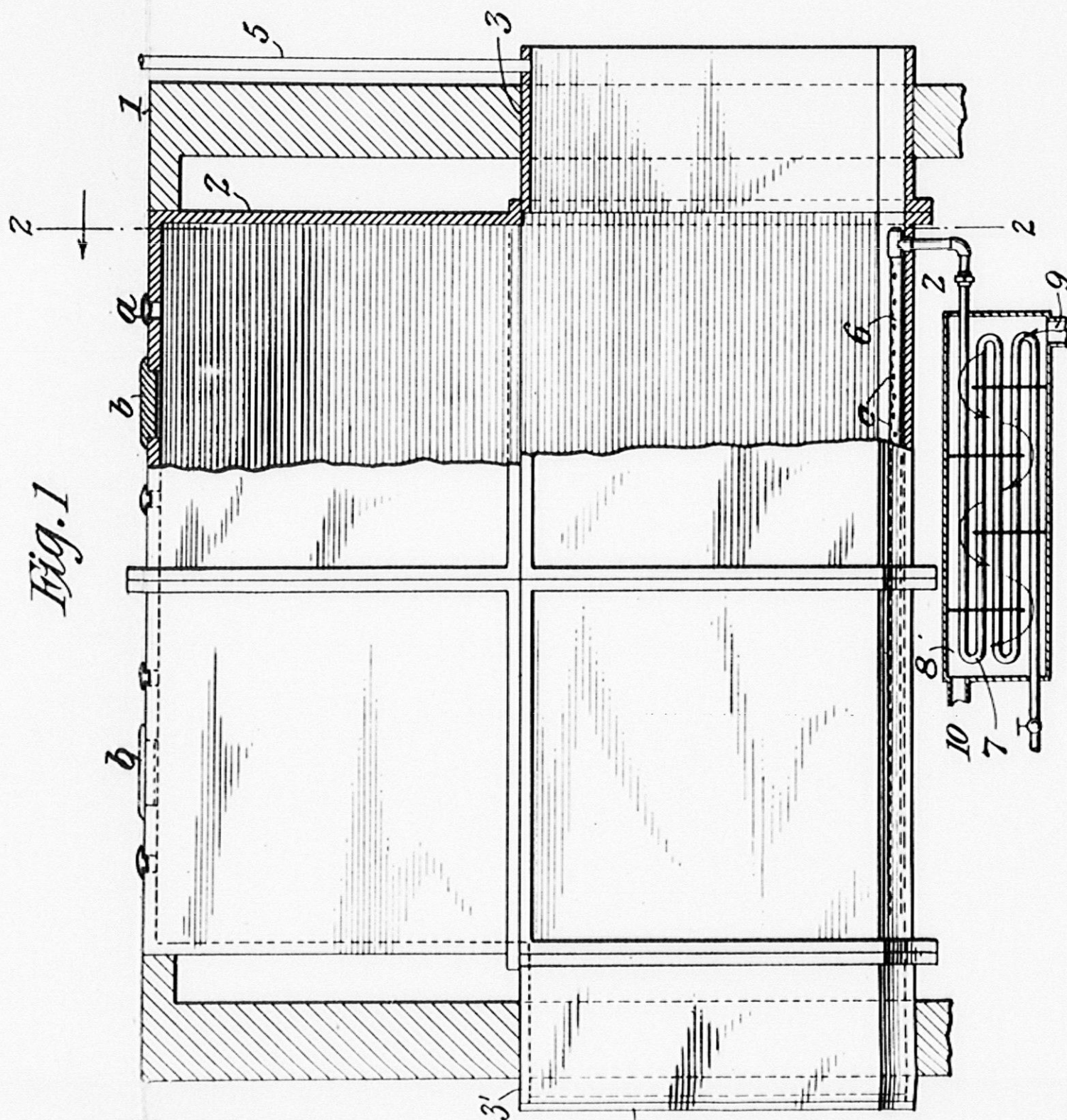


Fig. 1



INVENTOR:
 Charles S. Palmer.

BY
 Merwin S. Swanton
 his ATTORNEYS

UNITED STATES PATENT OFFICE.

CHARLES S. PALMER, OF PITTSBURGH, PENNSYLVANIA.

PROCESS OF AND APPARATUS FOR MAKING NATURAL-GAS SUBSTITUTE.

1,268,763.

Specification of Letters Patent.

Patented June 4, 1918.

Application filed October 5, 1917. Serial No. 194,834.

To all whom it may concern:

Be it known that I, CHARLES S. PALMER, a citizen of the United States, residing in Pittsburgh, county of Allegheny, and State of Pennsylvania, have invented certain new and useful Improvements in Processes of and Apparatus for Making Natural-Gas Substitute, of which the following is a specification.

My invention relates to improvements in the manufacture of combustible gases from coal and has for its objects the economical and convenient production of a coal-and-water-gas mixture from bituminous coal, the manufacture preferably being carried out by successive operations in the same apparatus, although obviously if desired the successive steps of the manufacture may be conducted in different units of the plant.

My invention has for its objects the production of a fuel gas which has a relatively high thermal value and yet is so low in cost as to compare favorably from a thermal standpoint with natural gas having 1,000 B. T. U. per cubic foot and costing ten cents per thousand cubic feet, or with bituminous coal having 10,000 B. T. U. per lb., and costing \$2.00 per ton.

At the present time the principal methods employed in the manufacture of fuel gases comprises the coal or illuminating gas method which produces gas consisting essentially of methane and hydrogen with a minor percentage of CO and heavier hydrocarbons and having a thermal value of about 500 to 600 B. T. U. per cubic foot and yielding about 65% of coke with numerous by-products as tar, ammonia, benzene, etc.; the water gas process which yields an uncarbureted product that consists essentially of hydrogen and carbon monoxid and has a thermal value of 350 B. T. U. per cubic foot; and the producer gas process which yields a gas which has a very low thermal value of but 150 B. T. U. per cubic foot and consists principally of nitrogen and carbon monoxid with a minor percentage of hydrogen.

The coal gas process as at present practised, especially when produced in coke by-product ovens, is in a very high state of efficiency. In the intermediate water gas process, however, which is usually the basis of the common city gas supply, the present

process is highly wasteful, in fact about 50 to 60% more coal is consumed in the process merely for maintaining the necessary heat for the water gas reaction than is necessary, *i. e.*, the present practice consumes about 50% of hard coal or coke for maintaining the reaction temperature, whereas, theoretically but about 30% should be required. Primarily this is due to the wasteful employment of an intermittent air blast for periodically restoring the temperature of reaction as well as being due to the great length of time required when employing the modern retorts in order to heat the contents to the reacting temperature and the consequent serious loss of heat throughout said period by radiation and otherwise.

My invention is fully set forth and described in the accompanying drawings and specification forming a part thereof, in which—

Figure 1 is a longitudinal vertical section; and

Fig. 2 is a transverse vertical section along the line 2—2 of Fig. 1.

In the drawings the reference numeral 1 designates the fire-brick walls of the heating chamber having the usual heating flues therein and 2 designates a long narrow chamber or retort, preferably for example of about 20'x10' and 8" to 10" wide having a V-shaped bottom, the walls being about $\frac{1}{2}$ " in thickness. The heating chamber communicates with the usual checker-work of regenerator furnaces positioned below the same (not shown). Preferably such retort is constructed in sections and the same are constructed of a highly refractory, non-oxidizable metal such as ni-chrome steel, though nickel steel or nickel may be also employed in lieu thereof. Suitable poke holes *a* and charging holes *b* are provided at the top of the retort, as shown. The lower section preferably has cast iron extensions 3, 3' communicating with a suitable discharge reservoir for the coke residuum at the end 3 and having a suitable cast iron door 4 covering the end or extension 3'. A gas outlet conduit 5 communicates with the interior of said retort through the said end 3. In the apex of the bottom of the lower section is a longitudinal steam line 6 which has perforations *c* at intervals along the top in order

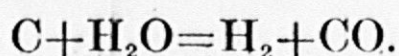
to uniformly admit steam into the bottom of the retort.

Referring to the drawings and the construction shown therein, the operation of the process is as follows:

Sufficient bituminous coal is introduced through the charging holes to substantially fill the entire retort. Such coal is then coked at the usual temperature by means of heat conducted thereto from the gases in flues through the highly conductive, thin, metallic walls of the retort. The gas so generated is conducted off through the pipe 5, to containers or reservoirs therefor and the coke residuum may be removed into another similar retort through the outlet 3, in order to subject the same to the second stage of the process, but preferably said second stage is conducted in the same retort. The coal gas so obtained may be suitably scrubbed and otherwise treated in the usual manner to obtain the by-products therefrom, such as tar, ammonia, benzol, etc.

Owing to the high conductivity of the thin walls of my retort, which are preferably about $\frac{1}{2}$ " thick, and should not exceed $1\frac{1}{2}$ " in thickness in any event, even the coking may be accomplished in a shorter space of time than the present process and as a consequence there is but a minimum of fuel and time required for this stage of the process.

In order to produce water gas from the coke residuum of the first stage of the process, the retort is first sufficiently heated by the regenerator furnace-gases, passing through the flues so as to maintain the mass incandescent by indirect heat, only, throughout the second stage of the process, preferably at about 1100° C. Steam is then introduced through the steam-line 6 in sufficient quantities to convert the incandescent coke into water gas according to the formula



Preferably the steam is superheated, superheating being decidedly more efficient. Owing to the high heat-conductivity as above stated, of the thin metal walls of my retort, this second stage of the process is completed very rapidly as compared with the usual procedure and the periodically injected hot blasts of atmospheric air are not required in order to maintain the requisite temperature for the production of water gas.

"Nichrome," and other nickelous alloys consisting principally of nickel, and even nickel itself, unlike iron, ordinarily, while difficultly oxidizable at high temperatures, soon become superficially loaded with carbon, when subjected to direct contact with very hot reducing gases having a high carbon content, particularly at temperatures between 1000° and 1100° C. Not only is such carbon physically deposited upon and

throughout the exposed surface layer of the metal as graphitic carbon, but also it will be found to be in chemical combination therewith in the form of carbids. The consequence of such loading of nickelous metal with carbon is that it rapidly deteriorates structurally, often becoming weakened to such an extent as to in many cases even crumble to pieces while being subjected to temperatures up to 1100° C., and furthermore its specific heat conductivity becomes very greatly reduced. Under the conditions however to which the nickelous envelop is subjected during the operation of my process, the inner portion thereof is protected from the carbonizing or carbid forming action of the reducing gases in the retort, because of the fact, as my investigations have shown, that the nickelous portion of the envelop is extremely thin and, at the high temperature to which it is subjected, is at least partially pervious to the passage thereinto of the strongly oxidizing external gaseous heating medium, such as the producer-gas and hot air mixture which is preferably employed by me. The result is that the deleterious action of the carbonizing and carbid-forming gas within the retort upon the inner exposed layer of the envelop is substantially, if not entirely, prevented, and instead of the structure of the envelop being seriously weakened and the specific heat conductivity of the envelop being greatly diminished, as would ordinarily be expected by those familiar with the behavior of nickel and its alloys consisting essentially of nickel, the envelop is found to be extraordinarily durable and even after repeated operations of my process herein to retain to a remarkable degree its specific heat conductivity.

In view of the high conductivity of the walls of the retort and the elimination of the necessity of injecting a blast of heated air thereinto as aforesaid, I am able to obtain from the coke a maximum yield of a water gas mixture having a minimum amount of CO₂ and substantially free from nitrogen, i. e., about .5% and less than 1% in all cases where the process is properly carried out.

The coal gas obtained has a calorific value of about 600 and water gas mixture of about 400 B. T. U. per cubic foot. By a suitable mixing of the two foregoing a calorific value of 400 to 500 B. T. U. per cubic foot can be obtained.

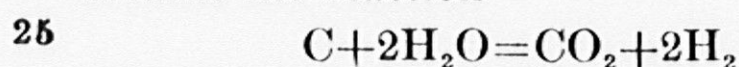
The aforesaid "ni-chrome" alloy approximates in capacity

Ni-----	50 to 60%
Cr-----	10 to 20%
Fe-----	15 to 25%
Balance scattering.	

Ni-chrome alloy approximates 1200° C. melting point and is relatively non-oxidizable. Moreover it corresponds substantially

to cast iron in tensile strength, heat conductivity and coefficient of expansion.

As above stated the crux of this invention by which I am enabled to obtain a maximum yield of mixed gases having a high calorific value, resides in the indirect heating of the reacting mass due to the fact that the non-oxidizable, highly-resistant, thin, metal wall promotes a quick and ready transfer of the large amount of heat required from the outside to the inside of the retort in which the water gas reaction is proceeding, whereas, were the walls constructed relatively thick, say in excess of 1½", even though they were of metal, such transfer of the necessary heat to accomplish the quick conversion of the coke or hard coal into water gas could not be accomplished, and prolonged heating of the coke by the periodic injection therinto of hot blasts of air would be necessary in order to prevent the temperature falling below the point at which the water gas reaction proceeds efficiently, because the reaction



which occurs at lower temperatures, must be avoided in order to obtain an efficient and satisfactory substitute for natural gas. Furthermore, the residual coke from the second stage of my process containing however much residual good material, may be discharged, through partly housed and closed ways and crushing rolls, (not shown), to a producer gas plant which consumes the residual coke, producing much producer gas of low thermal value but which is adapted in suitable combination with heated air, economizers and regenerators to heat the coal and water gas retorts in the first two stages of the process.

In my preferred process I also employ nichrome steel or other correspondingly highly resistant non-oxidizable metal in the steam line and the superheater, since not only am I thus able to superheat the steam to the reaction temperature when desired without the destruction of the superheater, but also I avoid the inevitable reduction in temperature which occurs upon the introduction of ordinary superheated steam, which usually is at a temperature of 500 to 800° F. Also in addition to this, the employment of steam at a temperature considerably in excess of ordinary superheated steam, for example, from 750° C. to 1100° C., is believed to materially promote the dissociation of the steam, thereby increasing the chemical activity of its elements with the consequence that the formation of hydrocarbons by the interaction of hydrogen of the steam and the carbon of the coke is accordingly facilitated. Such a superheater is illustrated in Fig. 1 in which a coil 7 is positioned in a superheating chamber 8, the said chamber being provided

with gas inlet and outlets 9 and 10 respectively. In this construction the coil 7 and the entire steam pipe 6 are constructed of nichrome steel, nickel-steel, nickel or other suitable, highly refractory, substantially non-oxidizable, metal.

While nickel itself, when employed for the retort or the superheater piping forms a thin superficial coating of nickel oxid, I have found that the formation of this crust does not seriously retard the conduction of heat therethrough and furthermore, that said crust does not increase in thickness and cause the deterioration or destruction of the retorts or superheater piping.

As is apparent from the foregoing description, the employment of a highly resistant, non-oxidizable metal retort, having walls not exceeding 1½ inches in thickness, has the following important advantages over the present coal gas, water gas and producer gas processes as commercially practised:

First, it avoids the necessity for quenching the coke produced in the usual coal-gas process, after the removal of the coke from the coke oven and prior to its introduction in the water-gas or producer-gas retort, and thereby substantially all of the heat retained in the coke at the end of the coal-gas stage is conserved, since in my process, as above stated, the water-gas process is preferably conducted in the same retort as the coal-gas process immediately following the completion of the latter.

Second, it avoids the necessity for the use of an intermittent air blast to maintain the reacting temperature and thereby prevents the dilution of the gas with large amounts of nitrogen from the heated air blast, and also the maintenance of the uniform temperature enables me to obtain a much more economical and increased yield of gas of a more uniform composition.

Third, the employment of non-oxidizable highly resistant metallic walls, which should not exceed 1½ inches in thickness, and are preferably ½ inch in thickness, as a substitute for cast iron or other oxidizable metal retorts or clay and silica retorts now used, permits of the reaction being completed in a much shorter period of time because of the coal gas reaction being continuous in but a fraction of the time required when the present retorts, which heat extremely slowly, are employed.

Fourth. One of the advantages of employing high-pressure superheated steam at a temperature of 750° C. to 1100° C. is believed to be due to the formation of increased amounts of higher hydrocarbon due to the increased dissociation of the steam since it is well known that the addition of one or more atoms of carbon or hydrogen to a hydrocarbon in many cases very substantially increases the thermal value thereof.

This is shown by the following table in which is given the relative thermal units per cubic foot of different hydrocarbons:—

		Cal. per kg.	B. T. U. per cub. ft.
5	C_2H_2	11,917	1,554
	C_6H_6	10,102	3,954
	CO	2,436	,342
	C_2H_6	12,420	1,870
10	C_2H_4	11,931	1,677
	H_2	34,180	,344
	CH_4	13,320	1,070

In some cases, depending upon the character of the coal and the by-products desired, a small amount of superheated steam can be advantageously injected into the charge in the first or coal-gas stage of the process.

By employing my improved process I can continuously, as distinguished from intermittently, produce 500 to 1000 cubic feet of water-gas per square foot of heating surface in every 24 hours, the same approximating the following average composition:

	%	%
CO ₂ -----	2	to 12
"C ₂ H ₂ ," heavy hydrocarbons--	0.1	" 0.5
H ₂ -----	50	" 60
30 "CH ₄ ," paraffins-----	1	" 10
CO-----	20	" 30
N-----	Less than 1%	

Obviously, in those cases where the extension 3 is not in communication with the discharge reservoir for the coke residuum resulting from the second or water gas stage of the process, said extension or end 3 is closed in the same manner as extension 3' by a cast iron door (not shown).

The employment of platinum, gold, iron, (and by iron I include iron having such carbon content as to come within the range commonly termed steel,) as the material of the envelop referred to in the process claims herein, or, as the material of the retort referred to in the apparatus claims herein, is specifically disclaimed.

The expression "a metal associated with iron in the 'iron group' in Mendeléjeff's table and of greater atomic weight, than iron," refers to metals which are associated with iron in the group commonly known as the "iron group" consisting of iron, atomic weight 55.84, nickel, atomic weight 58.65 and cobalt, atomic weight 58.97.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. In the manufacture of water-gas, the process, which consists in confining a charge of fuel in a space having an envelop which consists principally of a metal associated with iron in the "iron group" in Mendeléjeff's table and of greater atomic weight than

iron, said envelop not exceeding 1½ inches in thickness, being of good heat conductivity and not deleteriously affected when subjected to the action of a mixture of producer gas and air heated to a temperature of 1100° C., for prolonged periods of time, supplying sufficient heat to said charge through said conductive envelop from a strongly oxidizing, highly-heated, gaseous medium caused to contact with the outer surface of said envelop, to promote the water-gas reaction in said charge, maintaining said temperature by conduction of heat to said charge through said conductive envelop without the direct introduction to said chamber of substantial quantities of an air blast, simultaneously supplying a sufficient quantity of steam to said charge to effect the water-gas reaction so as to produce a strongly, reducing, highly-heated, gaseous medium in contact with a substantial portion of the inner surface of said envelop.

2. In the manufacture of water-gas, the process which consists in confining a charge of fuel in a space having an envelop which consists principally of a metal associated with iron in the "iron group" in Mendeléjeff's table and of greater atomic weight than iron, said envelop not exceeding 1½ inches in thickness, being of good heat conductivity and not deleteriously affected when subjected to the action of a mixture of producer gas and air heated to a temperature of 1100° C., for prolonged periods of time, supplying sufficient heat to said charge through said conductive envelop from a strongly oxidizing, highly-heated, gaseous medium caused to contact with the outer surface of said envelop, to promote the water-gas reaction in said charge, maintaining said temperature by conduction of heat to said charge through said conductive envelop without the direct introduction to said chamber of substantial quantities of an air blast, simultaneously supplying a sufficient quantity of highly superheated steam, at a temperature in excess of 750° C., to said charge to effect the water-gas reaction, so as to produce a strongly, reducing, highly-heated, gaseous medium in contact with a substantial portion of the inner surface of said envelop and then recovering the evolved gas.

3. The process of manufacturing fuel gas, which consists in confining a charge of bituminous coke against the ingress of air in a space having an envelop which consists principally of a metal associated with iron in the "iron group" in Mendeléjeff's table and of greater atomic weight than iron, said envelop not exceeding 1½ inches in thickness, being of good heat conductivity and not deleteriously affected when subjected to the action of a mixture of producer gas and air heated to a temperature of 1100° C.,

heating said charge by means of heat conducted through said conductive envelop to a temperature sufficient to produce coal-gas from said charge and maintaining said temperature until substantially all of the volatile matter is expelled, withdrawing the liberated gas from said chamber, then conducting sufficient heat through the envelop of said space from a strongly oxidizing, highly-heated, gaseous medium caused to contact with the outer surface of said envelop to elevate the temperature of the residual coke therein so as to promote the water-gas reaction, maintaining the said reacting temperature of said coke, while simultaneously introducing steam, without the substantial introduction of oxygen, for a sufficient time to convert the greater part of said coke into water-gas, and thereby produce a strongly reducing, highly-heated, gaseous medium in contact with a substantial portion of the inner surface of said envelop and recovering the evolved water-gas.

4. In the manufacture of water-gas, the process which consists in confining a charge of carbonaceous fuel in a space having an envelop which includes a medium consisting principally of nickel, said envelop being of good heat conductivity and being sufficiently thin to be substantially penetrated into by an external strongly oxidizing, highly-heated, gaseous medium brought into contact with the outer surface of said envelop and also sufficiently thin to permit of the substantial neutralizing by said oxidizing medium of the graphite and carbid-forming tendency of a strongly reducing, highly-heated gaseous medium simultaneously brought into contact with the inner surface of said envelop, said envelop being substantially non-oxidizable when subjected to the action of a mixture of producer gas and air heated to a temperature of 1100° C., supplying sufficient heat to said charge through said conductive envelop, from a strongly, oxidizing highly-heated, gaseous medium caused to contact with the outer surface of said envelop, to promote the water-gas reaction in said charge, maintaining said temperature by continued conduction of heat from said gaseous medium through said conductive envelop to said charge without the direct introduction into said chamber of substantial quantities of air, simultaneously supplying a sufficient

quantity of steam to said charge to effect the water-gas reaction, so as to produce a strongly reducing, highly-heated, gaseous medium in contact with a substantial portion of the inner surface of said envelop and then recovering the evolved gas.

5. In an apparatus for producing water-gas, the combination comprising a heating chamber provided with a gas-inlet, a substantially closed retort positioned in said chamber, a substantial portion of said retort being relatively narrow and having extremely thin, refractory, substantially non-corrosive walls consisting principally of nickel and not exceeding one and one-half inches in thickness, an outlet conduit communicating with the interior of said retort for conducting gas therefrom and means for distributing steam throughout the interior of said retort.

6. In an apparatus for producing water-gas, the combination comprising a heating chamber provided with a gas-inlet, a substantially closed retort positioned in said chamber, a substantial portion of said retort being relatively narrow and having thin, refractory, substantially non-corrosive walls consisting principally of nichrome and not exceeding one and one-half inches in thickness, an outlet conduit communicating with the interior of said retort for conducting gas therefrom and means for distributing steam throughout the interior of said retort.

7. In an apparatus for producing water-gas, the combination comprising a heating chamber provided with a gas-inlet, a substantially closed retort positioned in said chamber, a substantial portion of said retort being relatively narrow and having thin, refractory, substantially non-corrosive walls not exceeding one and one-half inches in thickness composed of a metal associated with iron in the "iron group" in Mendel-éjeff's table and of greater atomic weight than iron, an outlet conduit communicating with the interior of said retort for conducting gas therefrom and means for distributing steam throughout the interior of said retort.

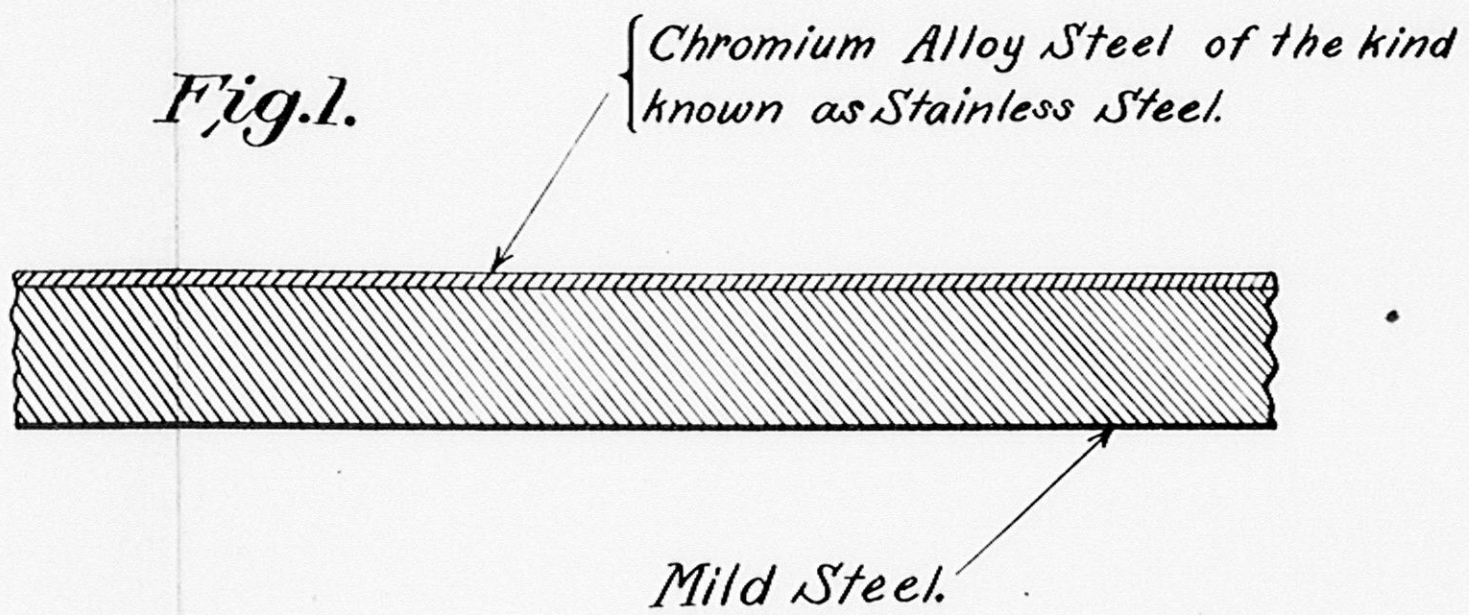
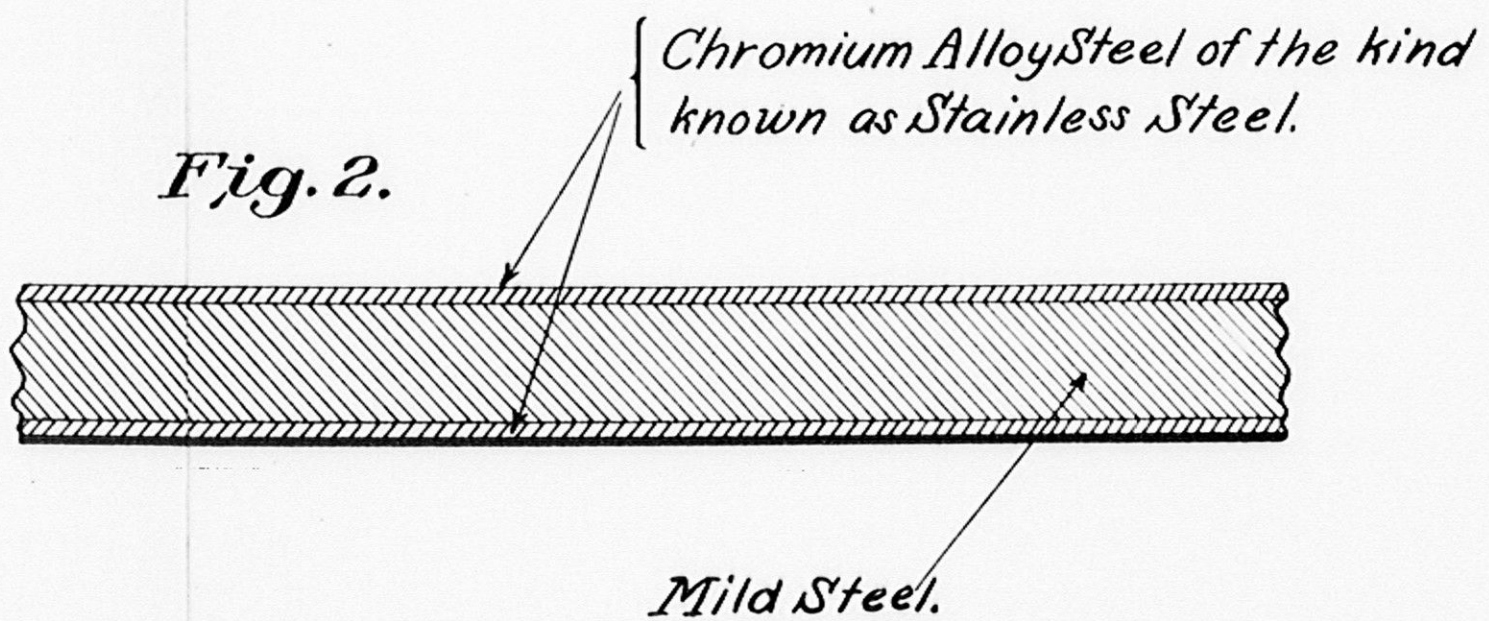
In witness whereof, I have hereunto set my hand at the city of Pittsburgh, county of Allegheny and State of Pennsylvania, this third day of October, 1917.

CHARLES S. PALMER.

A. E. GILLESPIE.
SHEET METAL.
APPLICATION FILED JULY 31, 1918.

1,306,690.

Patented June 17, 1919.

Fig. 1.*Fig. 2.*

Inventor
Alexander Edwin Gillespie

Witnesses

J MacCarte

By his Attorneys

Freeman & Wight

UNITED STATES PATENT OFFICE.

ALEXANDER EDWIN GILLESPIE, OF LONDON, ENGLAND.

SHEET METAL.

1,306,690.

Specification of Letters Patent.

Patented June 17, 1919.

Application filed July 31, 1918. Serial No. 247,653.

To all whom it may concern:

Be it known that I, ALEXANDER EDWIN GILLESPIE, a subject of the King of Great Britain, residing at 57 Casewick road, West Norwood, London, England, have invented new and useful Improvements in Sheet Metal, of which the following is a specification.

This invention relates to the manufacture of sheet metal having an incorrodible surface and to the manufacture of certain useful articles therefrom.

The object of the invention is to obtain such metal in the form of compound sheets which are capable of being rolled, hammered, stamped or otherwise worked by ordinary methods, the said sheets and articles made therefrom being incorrodible to the extent that they are proof against all ordinary culinary acids, fruit juices and the like.

In the accompanying drawings—

Figure 1 illustrates one form of my invention wherein a sheet of mild steel is coated on one side with chromium alloy steel of the kind known as stainless steel.

Fig. 2 is a similar view showing a form of my invention in which a sheet of mild steel is coated on both sides with chromium alloy steel of the kind known as stainless steel.

The drawings show in a general way the relative thickness of the coating and the body of the sheet, but on a much magnified or enlarged scale.

In carrying out the invention a billet, bar, plate or sheet of chromium alloy steel of the kind known as "stainless" or "rustless" steel (that is, a low-carbon steel containing about 10 to 15 per cent. of chromium) is applied to a billet, bar, plate or

sheet of ordinary mild steel and welded thereto by hammering, rolling, or pressing under the action of heat. The dimensions of the chromium steel and ordinary steel respectively are chosen according to the purpose in view. In certain cases the chromium steel is applied to both sides of the ordinary steel. The compound billet bar, plate or sheet thus obtained is then if necessary heated and rolled into a sheet of any desired thickness; for example, it may be reduced to a sheet thin enough for the manufacture of cans for the packing and storage of fruits, pickles and other solid foodstuffs, or it may be stamped or otherwise worked into saucepans and like culinary utensils. It may be also employed for the manufacture of dental plates, the steel coated on both sides being specially suitable for this purpose. The said dental plates may be provided with artificial teeth made of the same metal but faced with enamel of suitable color.

What I claim is:—

1. A new article of manufacture having an incorrodible surface, consisting of a sheet of mild steel coated on one side with chromium alloy steel of the kind known as stainless steel.

2. A new article of manufacture, consisting of a sheet of mild steel coated on both sides with chromium alloy steel of the kind known as stainless steel, whereby incorrodible surfaces are provided for the purposes specified.

In testimony that I claim the foregoing as my invention I have signed my name this 10th day of July, 1918.

ALEXANDER EDWIN GILLESPIE.

UNITED STATES PATENT OFFICE.

FLOYD C. KELLEY, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SURFACE-ALLOYED METAL.

1,365,499.

Specification of Letters Patent.

Patented Jan. 11, 1921.

No Drawing.

Application filed October 23, 1919. Serial No. 332,694.

To all whom it may concern:

Be it known that I, FLOYD C. KELLEY, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Surface-Alloyed Metals, of which the following is a specification.

The present invention relates to the surface treatment of metals, particularly iron, to produce an alloy with the foundation metal, and which has useful characteristics not possessed by the foundation metal, as, for example, superior corrosion resisting properties, luster, or color.

I have discovered that when metallic chromium is brought into surface contact under suitable conditions with a foundation metal, such as iron, nickel, molybdenum, or tungsten, that the chromium enters the surface layer of the foundation metal below the melting point of either metal, and forms a layer of alloy decreasing in richness of chromium content from the surface to the interior of the foundation metal, and that the resulting alloy is resistant to corrosion and oxidation, is ductile, not excessively hard, has a bright shiny luster, and will take a high polish.

In carrying out my invention, the foundation metal, for example, iron or steel, is heated in contact with powdered metallic chromium under non-oxidizing conditions to a temperature of about 1200 to 1350° C. Preferably the powdered metallic chromium is admixed with a refractory, inert material, for example, alumina or magnesia, say, in equal proportions or thereabout. Non-oxidizing conditions may be produced by passing a current of non-oxidizing gas such as hydrogen, for example, through the receptacle, or by evacuating the receptacle. It is advantageous in some cases to add a small proportion of powdered metallic aluminum, to the mixture to prevent oxidation of the chromium. When treating molybdenum or tungsten with chromium a temperature as high as 1500° C. may to advantage be used; in other words, the range of treating temperatures is from 1200 to 1500° C.

The duration of the treatment will vary with the penetration of alloyage desired. When a surface layer of alloyage about 30 to 40 mils is desired the treatment at the proper temperature is continued for about

four hours. A greater penetration is produced by a proportionately longer treatment. A surface alloy produced by my process without fusion may be termed a cementation alloy to distinguish the same from an alloy produced by fusion.

A section of the chromized metal, when polished and etched, shows a well-defined zone of metal adjacent the surface in which recrystallization of the foundation metal has taken place by the penetration of the chromium into the foundation metal and alloyage therewith. Crystals extend from the outer band or zone of alloy into the unalloyed foundation metal, and in some cases grains of unalloyed foundation metal extend into the alloy band. In some instances a well-defined band of alloy appears intermediate the outer chromium alloy and the foundation metal. The grain structure of the chromized metal is usually relatively large, the longer axis of the grains usually extend at right angles to the surface through which the chromium entered.

Chromium treated metal similarly to aluminum treated metal resists corrosion in the presence of moisture. For example, a salt spray which will rapidly corrode untreated iron leaves chromized iron unaltered. The chromium treated surface will take a high polish and has a bright luster.

The chromium treatment causes a decarbonization of the iron. The decarbonized alloy shows ferrite structure with absence of carbon. The carbon content may be restored and increased if desired by heating the treated metal in a hydrocarbon gas, or in contact with carbon. The carburized metal may be quenched in the usual manner to harden the same.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The process of providing a metal with a surface alloy of chromium which consists in heating the metal under non-oxidizing conditions in contact with a powdered charge containing metallic chromium at a temperature of at least about 1200° C., but below the melting point of said metal.

2. The process of providing a metal with a surface alloy of chromium which consists in heating the metal under non-oxidizing conditions at a temperature of at least about 1200° C., but below the melting point of said metal, in contact with a powdered mix-

ture containing chromium and a refractory inert material.

3. The process of providing iron with a surface alloy of chromium which consists in heating the iron in hydrogen in contact with a charge of chromium and a refractory material to a temperature of about 1200 to 1350° C.

4. The process of providing iron with a surface alloy of chromium which consists in heating the iron in hydrogen in contact with a mixture of chromium, aluminum oxid and aluminum all in powdered form to a temperature of about 1200 to 1350° C.

5. As a new article of manufacture, a foundation metal having a surface layer consisting of a cementation alloy of chro-

mium with said foundation metal, the chromium content of said layer decreasing toward the interior of said metal, said alloy having a shiny luster, being capable of taking a high polish and being resistant to corrosion.

6. A new article of manufacture, comprising an iron article having a surface layer of iron chromium alloy produced by cementation, the chromium content of said layer decreasing in chromium content from the surface to the interior, the surface of said alloy being resistant to corrosion.

In witness whereof, I have hereunto set my hand this 21st day of October, 1919.

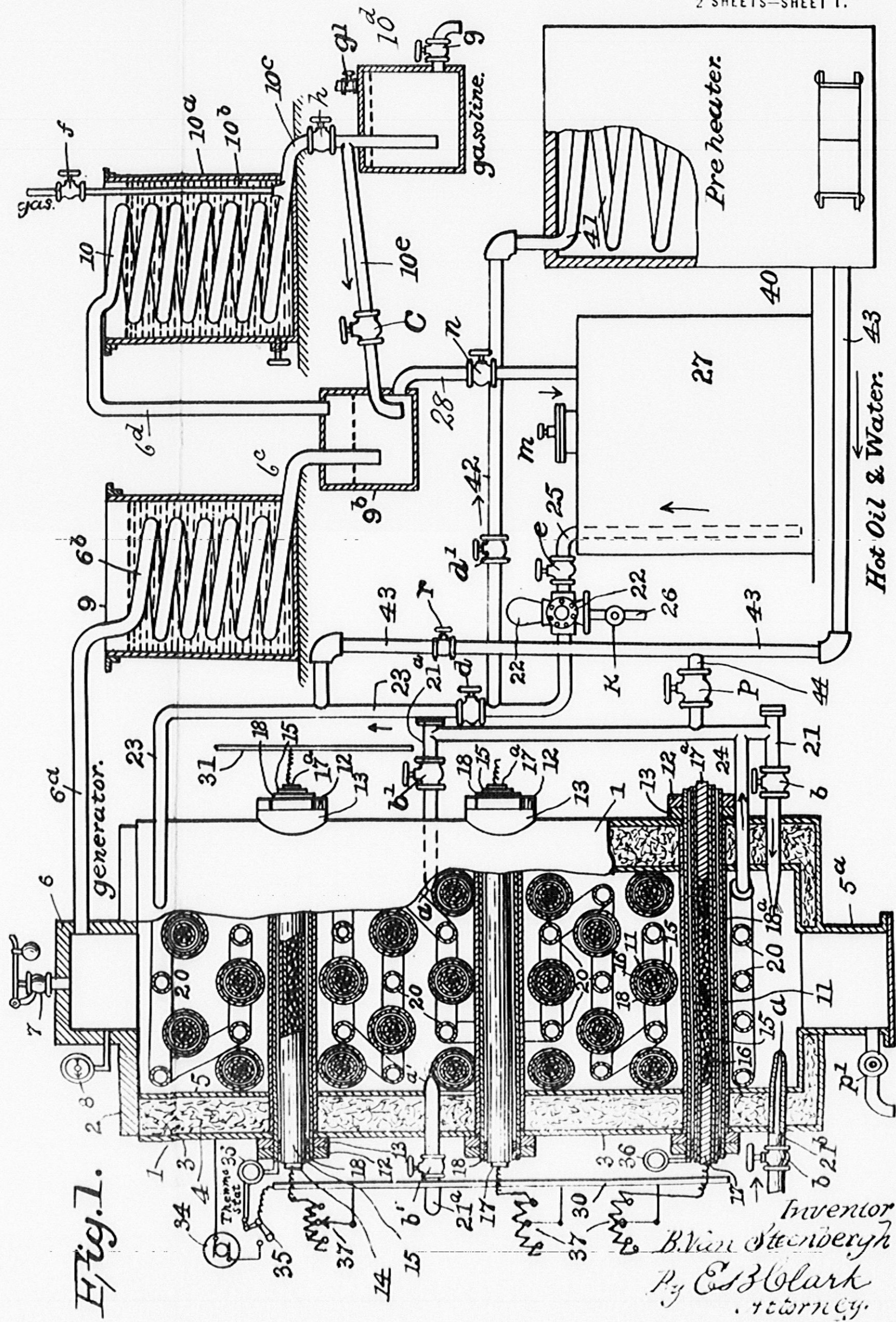
FLOYD C. KELLEY.

B. VAN STEENBERGH.
 APPARATUS FOR CRACKING MINERAL OIL TO PRODUCE GASOLINE.
 APPLICATION FILED DEC. 16, 1920.

1,407,339.

Patented Feb. 21, 1922.

2 SHEETS—SHEET 1.



B. VAN STEENBERGH.

APPARATUS FOR CRACKING MINERAL OIL TO PRODUCE GASOLINE.

APPLICATION FILED DEC. 16, 1920.

Patented Feb. 21, 1922.

2 SHEETS—SHEET 2.

Fig. 2.

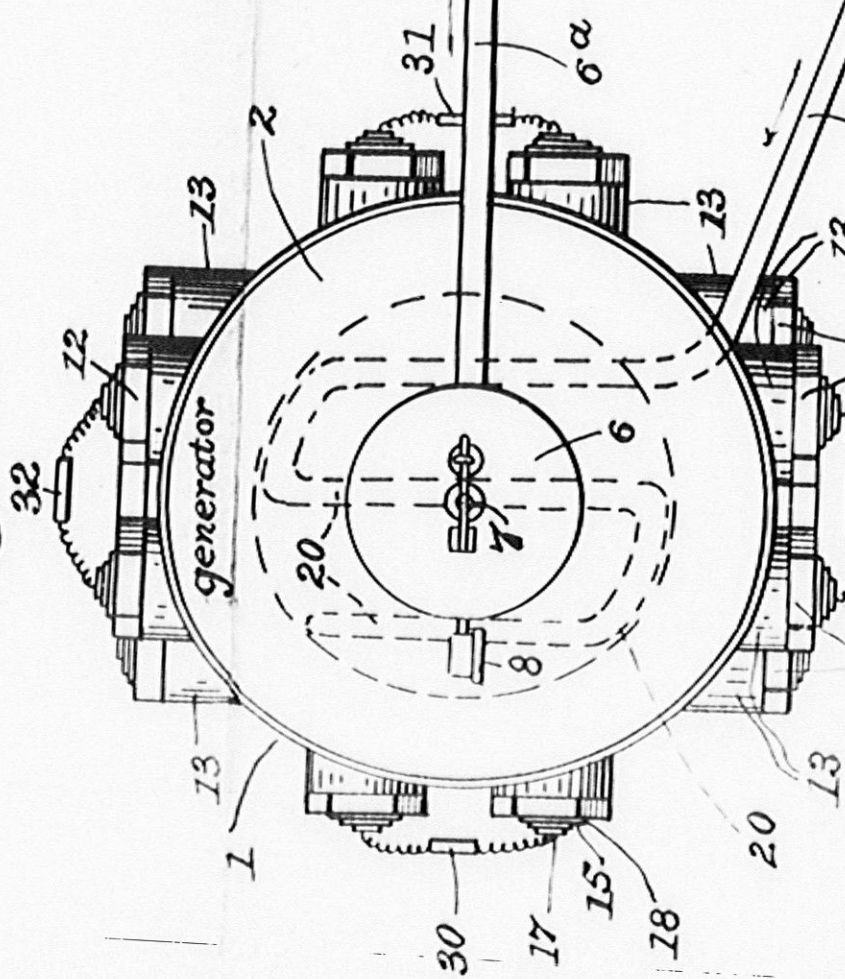
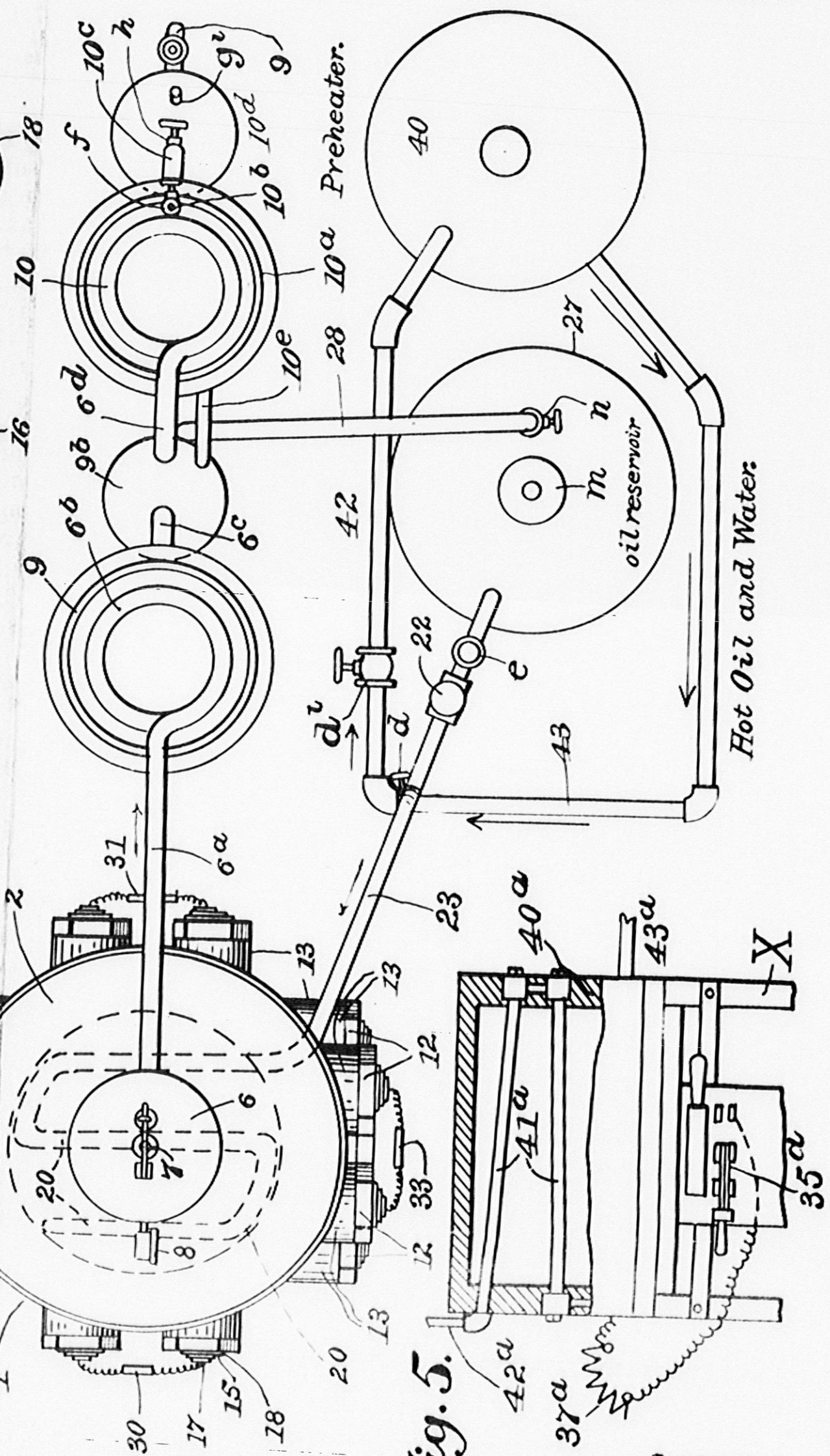
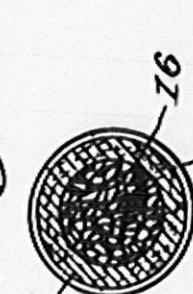


Fig. 3.



Fig. 4.



UNITED STATES PATENT OFFICE.

BURHANS VAN STEENBERGH, OF GOSHEN, NEW YORK.

APPARATUS FOR CRACKING MINERAL OIL TO PRODUCE GASOLINE.

1,407,339.

Specification of Letters Patent.

Patented Feb. 21, 1922.

Original application filed April 20, 1918, Serial No. 229,707. Divided and this application filed December 16, 1920. Serial No. 431,279.

To all whom it may concern:

Be it known that I, BURHANS VAN STEENBERGH, a citizen of the United States, residing at Goshen, in the county of Orange and State of New York, have invented certain new and useful Improvements in Apparatus for Cracking Mineral Oil to Produce Gasoline, of which the following is a specification.

This invention relates to an apparatus adapted for increasing the yield of low boiling point hydrocarbons, commonly known as gasoline, from petroleum or heavy distillate products by decomposition or cracking of the higher boiling point oils.

The principal object of my invention is to provide an apparatus adapted for carrying out a continuous process for dissociating or cracking heavier oils into oils of lighter gravities by spraying heavy oil into contact with an electrically heated surface or numerous heated surfaces spaced apart, and repeatedly subjecting the resulting mixtures of cracked and uncracked vapors to contact with spaced electrically heated surfaces at a temperature to produce decomposition or cracking into vapors of lower boiling point oils with the maximum production of vapors of lower boiling point oils and the minimum production of fixed gas by destructive decomposition of the oil.

Another object of my invention is to provide for pre-heating and superheating oil or oil and water or oil and steam by circulating under pressure through a coil, or a serpentine arrangement of pipe in a heating furnace and then injecting and spraying the heated oil and vapors into contact with heated surfaces at a cracking temperature in a generating chamber.

Another object of my invention is to provide a plurality of catalytic agent coated surfaces adapted to be electrically heated to a temperature to decompose the oil into lower boiling point oils and means for bringing free hydrogen or a hydrogen carrying gas or vapor into contact with said surfaces for hydrogenating the unsaturated hydrocarbons and carrying them away from the heated surfaces and out of the generator to prevent over-cracking or destructive decomposition and formation of fixed gases and carbon.

Another object of my invention is to provide for generating hydrogen carrying gas

by contact of steam and oil or steam in the presence of carbon, with surfaces heated approximately to 2,000° F. in the lower part of the generating chamber and passing it directly into contact with the hydrocarbon vapors and the heated catalytic agent surfaces above where dissociation or cracking is effected, for expediting the operation and exercising its hydrogenating effect at the moment of dissociation.

Another object is to provide for cracking oil by contact with a plurality of heated surfaces into vapors of lower boiling point oils, passing the remaining uncracked portions down over successively more highly heated surfaces to crack additional portions thereof and pass residual heavy oil or tarry matter into a receiver outside of the heating zone so that it will not be baked as hard carbon or lampblack upon the heated surfaces.

The catalytic agent coatings which form the heated surfaces serve the useful purpose of preventing the deposit and accumulation of carbon on the heaters; also the purpose of making gasoline of sweeter odor and better quality.

I preferably employ electric heaters for constantly maintaining the exact temperature, between 650° and 850° F. in the main and upper part of the generator, for best effecting the cracking operation, depending upon the quality and gravity of the oil being treated. The lower heaters are preferably heated to a higher temperature and may be heated to a temperature between 1,800° F. and 2,000° F. to serve as steam decomposing surfaces and for cracking heavier portions of oil which may flow down over them for final deposit of residual oily or tarry matter in a receiving chamber below or outside of the heating zone.

My apparatus, adapted for carrying out the above indicated process is illustrated in the accompanying drawing, in which:

Figure 1 represents a sectional elevation, showing part of the electric heaters in longitudinal section and part in cross section.

Fig. 2 represents a top plan view.

Fig. 3 represents, on enlarged scale, a transverse section of an electric heater, such as shown in Fig. 1.

Fig. 4 represents, on enlarged scale, a transverse section of an electric heater of modified construction.

Fig. 5 represents a sectional elevation of an electric furnace showing a serpentine arrangement of steam or superheating pipes.

I have discovered that cracking of high boiling point oil can be most economically and rapidly effected by direct contact with a heated surface and preferably provide that the surfaces in my apparatus shall be a few inches apart, and so arranged that the currents of mixed oil vapor and steam shall be repeatedly deflected and caused to impinge on numerous heated surfaces. In this arrangement I heat the contact surfaces only to that temperature which will decompose or crack the oil into lower boiling point fractions which are condensable to gasoline, and with the least possible destructive decomposition to fixed gas and fixed carbon. If the heated surfaces are too close together the hydrocarbon will be held too long in contact and will result in destructive decomposition and deposit of carbon. If the surfaces are too far apart the vapors are apt to flow past them too fast and escape proper cracking. The tendency, then, is for the operator to more highly heat the surfaces, with the result that those hydrocarbons brought into direct contact with the surfaces will be overheated and caused to deposit fixed carbon and make fixed gases, instead of the desired gasoline.

I preferably employ internally heated or electric heaters for maintaining a large external heating surface at the exact degree required for the most economical and effective operation. In order to expedite the cracking operation, I preferably preheat oil and water or steam under pressure to approximately 800° or 1,000° F. before subjecting them to contact with the catalytic agent coatings of the electric heaters where cracking is effected. The oil and water will preferably be preheated in coils or a serpentine arrangement of pipes in any desired heating furnace outside of my generator, but I also arrange coils or serpentine folds of pipe between the electric heaters in the generator. They thus act as heating surfaces and serve to deflect hydrocarbon vapors and steam into contact with the catalytic agent coatings of the electric heaters and to intermingle the cracked and uncracked vapors, so that a larger percentage of uncracked vapors will be caused to make contact with the heated surfaces and be cracked.

Referring to the drawing, the treating chamber or generator 1 is preferably constructed with a double plate iron shell 3 and 5, between which is placed a filling of non-conducting material 4, which may be of asbestos, mineral wool, ashes or brick. If brick is used, the outer metal shell may not be required. The top is closed by a cover 2, having a dome 6, and from the latter leads the vapor escape pipe 6^a which connects with the first condensing coil 6^b in a water tank 9.

The coil 6^b terminates in an outlet pipe 6^c which extends down into a seal-box 9^b, where its opening is sealed in the liquid. An outlet vapor pipe 6^d rises from the box and connects with the second condenser coil 10 in water tank 10^a, and this coil terminates in an outlet pipe 10^c having a valve *h* and extending down into a seal-box 10^d. This box is provided with a draw-off pipe and valve *g* for gasoline. A gas outlet pipe 10^b rises from the outlet end of coil 10 and is provided with a valve *f* to control the outflow of gas to a holder or a place of immediate use. The seal-box 10^d is not intended to serve as a reservoir, but merely as a trap or seal to prevent back flow of air into the condenser. The box may be filled, or partially filled, with liquid and a vent *g'* provided at the top in a well known manner. The representation is somewhat diagrammatic, but will be understood, and the apparatus will be made operative by those skilled in the art. A return pipe 10^e, having a valve *c*, connects with vapor pipe 10^c and with seal-box 9^b for returning any desired portion of oil to be again run through the treating apparatus.

A safety valve 7 and a pressure gage 8 are preferably applied to the dome 6.

In making my electric heater I may use an exterior iron tube 11, into which is inserted the electric heater proper, constructed as follows: A cardboard cylinder 14 is coated externally with insulating material, consisting of finely ground silica and finely ground carbonate of lime mixed with sodium silicate diluted with water to form a paste. This paste is moulded around the cylinder 14 and forms a coat or jacket 15. The tube thus formed is partially filled with granular carbon 16, and then carbon electrodes 17, 17^a are thrust into the ends of the tube making a tight fit so as to compress the carbon into the tube and form a resistance connection between the ends of the electrodes 17, 17^a.

The tubes 14, after the insulating jacket has hardened, is inserted in the outer iron tube 11 and the latter is placed in openings in the wall of the generator, extending at both ends beyond the same. The ends of the tube are screw threaded. Washers 13, provided with horizontally concave inner faces, are slid over the ends of the tubes and fit against the curved wall, and nuts 12 are then screwed onto the tubes so as to clamp them securely in place. Before the iron tubes are fitted into the generator walls they are covered with a coating or jacket of a catalytic agent containing a metallic oxide, such as oxide of calcium and oxide of magnesium mixed with diluted silicate of sodium. These are made into a paste which is applied as a coating or jacket 18 to each tube 11 before it is secured in place. This coating aids by catalytic action in cracking

the oil into lower boiling point products, and also prevents deposit of carbon.

When the electric current is passed through the heaters the cardboard tubes will be carbonized, forming in effect part of the resistance material of the heater.

A modified form of electric heater is shown in Fig. 4, in which a fire clay tube 15^a, baked at a temperature of about 3,000° F. is used instead of the iron tube 11. This also makes unnecessary the inner pasteboard tube and its insulating coating, since the fire clay tube acts as an insulator. The catalytic agent coating 18 may be applied to the outer surface of the fire clay tube.

The body of granular carbon 16 compressed between the ends of the electrodes 17, 17^a forms a resistance, by means of which a succession of small or short electric arcs are produced, thus converting electric energy into heat, whereby heating the tubes at that part filled with granular carbon from the inside to the surface.

The heat will be largely confined within the space between the walls of the generator, by reason of the heat insulating material in the walls. Since the granular material offers a much greater resistance to the electric current than is offered by the electrodes, heat will be generated principally in the parts of the heaters located between the inner walls of the generating chamber. Such localized heat is imparted to the preheater pipes 20 and the intervening space between them and the heaters.

Though I have shown and described a special construction of electric heater, I wish it to be understood that my invention of apparatus is not confined to this specific construction. Modifications in details of construction may be effectively used to carry out my process. Other kinds of electric heaters may be used. In my apparatus I am not limited to the particular catalytic agent coating above described, but other catalytic agents may be successfully used in hydrogenating oils, and particularly cracked hydrocarbon oils for saturating and making them sweet.

Within the generator chamber I arrange a series of pipes 20 in the form of a serpentine, as indicated by dotted lines in Fig. 2, between the electric heaters, Fig. 1, thereby forming numerous deflectors and tortuous passages. They also become highly heated and effective as decomposing surfaces, and fill the wider spaces between the electric heaters so as to deflect the oil vapors into contact with the catalytic agent coatings of the electric heaters. A mixed fluid, composed of approximately eighty per cent oil and twenty per cent of water may be forced into the pipe 20 at the top through a feed pipe 23, having a valve *d*, by a proportioning force pump 22 of a known kind. This pump con-

nects by a pipe 25, having a valve *e*, with the oil reservoir 27, and by pipe 26, having a valve *k*, with a water supply, not here shown. An outlet pipe 24 connects at the bottom of the generator with the preheater pipe 20 and connects by branches with the injector spray pipes 21, 21^a, located at different heights in the generator. The injectors have contracted nozzles *a*, *a'* and valves *b*, *b'*. For the purpose of preheating or superheating the mixed oil and water to a temperature of approximately 1,000° F., or any desired temperature, I provide a separate heating furnace 40, Figs. 1 and 2, having a preheating coil 41, and heat the same with a coal or oil fire in a well known manner, or I may use an electric furnace, Fig. 5. The mixing and forcing pump 22 will serve for supplying mixed oil and water to the preheating coil 41 by the pipe connections shown. A discharge pipe 42 having a valve *d'* for mixed oil and water leads from the discharge pipe 23 of the pump below its valve *d* and connects with the preheating coil 41. A discharge pipe 43 having a valve *r* leads from the bottom of coil 41 and connects with pipe 23 which leads to the serpentine pipe 20 in the generating chamber 1. A branch pipe 44 having a valve *P* connects pipe 43 directly with the injector spray pipe or nozzles 21, 21^a.

The oil reservoir 27 has a supply opening and cover *m*. A return oil pipe 28, having a valve *n*, leads from the seal-box 9^b into reservoir 27, for the return of heavy oil.

At the bottom, the chamber of the generator is provided with a settling pocket 5^a, having a draw-off faucet *p'* for any heavy oil or tarry matter which may collect.

The electric heaters which are parallel and lying at different levels are connected by bus-bars 30, 31 and 32, 33, respectively, which bars are connected in circuit with a source of energy 34; and a switch 35 controls the circuits. An automatic device, such as a thermostat 36, may be located at the outlet of each electric heater, or at suitable points in the wall of the generator to control the temperature by cutting out or cutting in the circuit, according to variations in the temperature. The temperature may thus be kept within fixed limits and practically uniform, and so long as the proper quantity of preheated oil or vapor and superheated steam is supplied the process will be continuous.

A rheostat 37 is preferably connected with each pair of electric heaters for controlling the electro-motive force, and consequently the temperature in each set of heaters. The heat will thus be regulated and controlled to the exact degree required for cracking the heavier hydrocarbon into lower boiling point hydrocarbons to make gasoline.

The mixed stream of oil and water may be

superheated in a detached coil 41 in a separate chamber 40 which may be heated in any well known manner, and passed therefrom to the spraying injector devices 21, 21^a, or first into the pipe 20 and then into the injectors, as above described.

In Fig. 5 I have shown a preheating pipe 41^a for oil or oil and water arranged in the form of a serpentine, or oppositely inclined sections of pipe, having end connections in an electric heating furnace 40^a mounted on legs X. A liquid inlet pipe 42^a connects with an upper pipe section 41^a and a discharge 43^a connects with the lower end of the serpentine. A switch board will be provided with any desired number of switches 35^a, connecting with a rheostat 37^a. The pipe sections 41^a may be composed of chromel, an alloy of nickel and chromium and well insulated in a well known manner. Oil and water may be preheated in this serpentine to the required temperature, as above described by reference to the furnace 40 and coil 41.

The operation is very simple and can be readily carried out by any one skilled in the art of distilling and refining oil. It will be simply necessary to turn on the electric current at the switch 35 and heat the electric heater 5 to the proper degree of temperature, between 650° and 850° F., and maintain them at that temperature during the cracking operation. The pump will be so set as to draw in about 80 per cent of oil and 20 per cent of water by volume. This mixture will be forced into a preheating coil, preferably in the outside furnace 40 or a furnace 50. The temperature in the preheater coil 41, or in a serpentine 41^a, Fig. 5, will be maintained at about 800° or 1,000° F. and the mixed oil and water and their vapors will be forced under pressure into and through the preheating coil or serpentine 20. By maintaining the fluids under pressure they will remain in a liquid condition and thus be more readily preheated. Of course, when the compressed liquids escape from the spraying nozzles of the supply pipes 21, 21^a, they expand and lose part of their heat, but are immediately brought into contact with the heated catalytic coating surfaces of the electric heaters, where decomposition or cracking is effected. This reduction of pressure on the oil and vapor in the generating chamber is important, as it permits them to expand and separate more or less from the water vapor and be impinged directly upon the heated surfaces where decomposition or cracking is effected at a lower temperature than would be possible under the pressure maintained in the preheating or superheating coils 41 or serpentine 51 and serpentine 20. Decomposition of comparatively heavy oil into vapors of lower boiling point oils is, therefore, very

rapid in the generating chamber. Owing also to the low pressure or lack of pressure in the generating chamber and to the fact that hydrogen is being passed up through the chamber, the vapors of freshly cracked oil will be quickly carried out of the chamber, so as to prevent destructive decomposition by too long exposure to the heated surfaces.

Hydrogen for exercising a hydrogenating effect by contact with the catalytic agent coatings and the vapors at the moment of cracking may be admitted by one of the lower injector pipes, as 21^b. I also propose to heat the lower group of electric heaters to a temperature between 1,800° and 2,000° F. and spray in contact therewith a mixture of superheated oil and steam, thereby decomposing the steam by causing its oxygen to combine with carbon present, either in the sprayed oil or that which has been deposited on the heaters, to form carbon monoxide and liberate hydrogen. The hydrogen of this mixture or that which is separately admitted by pipe 21^b will pass up through the generator and act as the hydrogenating agent to combine with the unsaturated hydrocarbons and make a pleasant, sweet odored gasoline. The carbon monoxide with other permanent gases will eventually pass off through the pipe 10^b to a holder. The lower group of electric heaters being more highly heated, as described, will cause heavy oily matter which may flow down over them to be cracked and converted into gasoline, so that very little tarry matter will pass into the pocket 5^a. It will be understood that most of the heated oil which is sprayed into the generator by the upper injectors 21^a will be vaporized and cracked by contact with the heaters above, but that, after such cracking operation, some of the remaining heavier oil will drop down and pass over the more highly heated surfaces below and become cracked or decomposed into oils of lighter gravity.

Any heavy uncracked oil, remaining after the cracking of oil in contact with the heaters above, will flow down over the more highly heated surfaces, between 1,800° F. and 2,000° F., below and be cracked into vapors of lower boiling point oils, and the residual heavy oil or tarry matter will pass down into the receiving chamber or pocket 5^a outside of the heating zone.

The apparatus can be operated with very little attention or manual labor and will be rapid and economical in operation.

This is a divisional application of my application, Serial No. 229,707, filed April 20, 1918.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An apparatus for producing gasoline,

superheated in a detached coil 41 in a separate chamber 40 which may be heated in any well known manner, and passed therefrom to the spraying injector devices 21, 21^a, or first into the pipe 20 and then into the injectors, as above described.

In Fig. 5 I have shown a preheating pipe 41^a for oil or oil and water arranged in the form of a serpentine, or oppositely inclined sections of pipe, having end connections in an electric heating furnace 40^a mounted on legs X. A liquid inlet pipe 42^a connects with an upper pipe section 41^a and a discharge 43^a connects with the lower end of the serpentine. A switch board will be provided with any desired number of switches 35^a, connecting with a rheostat 37^a. The pipe sections 41^a may be composed of chromel, an alloy of nickel and chromium and well insulated in a well known manner. Oil and water may be preheated in this serpentine to the required temperature, as above described by reference to the furnace 40 and coil 41.

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rapid in the generating chamber. Owing also to the low pressure or lack of pressure in the generating chamber and to the fact that hydrogen is being passed up through the chamber, the vapors of freshly cracked oil will be quickly carried out of the chamber, so as to prevent destructive decomposition by too long exposure to the heated surfaces.

Hydrogen for exercising a hydrogenating effect by contact with the catalytic agent coatings and the vapors at the moment of cracking may be admitted by one of the lower injector pipes, as 21^b. I also propose to heat the lower group of electric heaters to a temperature between 1,800° and 2,000° F. and spray in contact therewith a mixture of superheated oil and steam, thereby decomposing the steam by causing its oxygen to combine with carbon present, either in the sprayed oil or that which has been deposited on the heaters, to form carbon monoxide and liberate hydrogen. The hydrogen of this mixture or that which is separately admitted by pipe 21^b will pass up through the generator and act as the hydrogenating agent to combine with the unsaturated hydrocarbons and make a pleasant, sweet odored gasoline. The carbon monoxide with other permanent gases will eventually pass off through the pipe 10^b to a holder. The lower group of electric heaters being more highly heated, as described, will cause heavy oily matter which may flow down over them to be cracked and converted into gasoline, so that very little tarry matter will pass into the pocket 5^a. It will be understood that most of the heated oil which is sprayed into the generator by the upper injectors 21^a will be vaporized and cracked by contact with the heaters above, but that, after such cracking operation, some of the remaining heavier oil will drop down and pass over the more highly heated surfaces below and become cracked or decomposed into oils of lighter gravity.

Any heavy uncracked oil, remaining after the cracking of oil in contact with the heaters above, will flow down over the more highly heated surfaces, between 1,800° F. and 2,000° F., below and be cracked into vapors of lower boiling point oils, and the residual heavy oil or tarry matter will pass down into the receiving chamber or pocket 5^a outside of the heating zone.

The apparatus can be operated with very little attention or manual labor and will be rapid and economical in operation.

This is a divisional application of my application, Serial No. 229,707, filed April 20, 1918.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An apparatus for producing gasoline,

the combination with a generating chamber, of a plurality of spaced heating surfaces adapted to be internally heated, means for heating them to a temperature for cracking oil, spray pipes in the walls of the chamber, means for preheating oil and means for forcing said oil therethrough and to said spray pipes to discharge upon the heating surfaces.

2. In apparatus for producing gasoline, the combination with a generating chamber, of a plurality of spaced heating surfaces, adapted to be interiorly heated, means for heating them to a temperature for cracking oil, means between the heaters for deflecting vapors in contact with the heater means for preheating oil, an oil forcing device connecting therewith and a discharge pipe leading from said means and connecting with the generating chamber for spraying oil on said heating surfaces.

3. In apparatus for producing gasoline, the combination with a generating chamber, of an electric heater therein having suitable electrical connections, an oil spray pipe adapted to discharge and spray oil upon said heater, means adjacent to said heater in the generating chamber for preheating oil and deflecting the resulting vapors and means for forcing oil to said spray pipe.

4. In apparatus for producing gasoline, the combination with a generating chamber, of a plurality of spaced heating surfaces, adapted to be internally heated, oil preheating pipes between said heating surfaces to deflect vapors in contact therewith, an oil spray pipe connecting with the oil preheating pipe, adapted to spray oil in contact with said heated surfaces, and means for forcing oil under pressure into said preheater pipes.

5. In an apparatus for producing gasoline, a generating chamber having nonconducting walls, a vapor dome, an oil receptacle at the bottom below the heating zone, a plurality of electric heaters extending

through the walls and having electrical connections, oil spray pipes opening into the generating chamber, oil preheating pipes between said electric heaters and connected with said spray pipes and means for forcing oil into the preheater pipes.

6. In an apparatus for producing gasoline, a generating chamber having nonconducting walls, a vapor escape pipe at the top and a receptacle at the bottom outside of the heating zone for residual oil, spaced heater pipes extending through the walls having interior electric heaters and exterior coatings of catalytic material, means between said heater pipes for deflecting vapors into contact with the pipes, means for spraying oil on the heater pipes and means for admitting hydrogen to contact with said coatings, whereby the oil vapor, as cracked, may be hydrogenated.

7. In an apparatus for producing gasoline, a generating chamber having nonconducting walls, a vapor escape pipe at the top and a receptacle at the bottom outside of the heating zone for residual oil, spaced pipes extending through the walls having interior electric heaters and exterior coatings of catalytic material, a pipe for admitting hydrogen at the bottom of the generating chamber, and means for spraying oil on the heater pipes.

8. Apparatus for producing gasoline, comprising a generating chamber, a plurality of spaced heating surfaces adapted to be heated to a temperature for cracking oil, deflecting pipes between said heating surfaces, means for preheating oil outside of the generating chamber and means for connecting therewith adapted for spraying oil upon said heating surfaces.

In testimony whereof I affix my signature in presence of two witnesses.

BURHANS VAN STEENBERGH.

Witnesses:

JOHN B. LYDECKER,
ALFRED ADAMSEN.

UNITED STATES PATENT OFFICE.

FLOYD J. METZGER, OF NEW YORK, N. Y., ASSIGNOR TO AIR REDUCTION COMPANY,
OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

RETORT.

1,422,878.

Specification of Letters Patent.

Patented July 18, 1922.

No Drawing.

Application filed October 11, 1917. Serial No. 195,951.

To all whom it may concern:

Be it known that I, FLOYD J. METZGER, a citizen of the United States, residing in New York, county of New York, State of New York, have invented certain new and useful Improvements in Retorts, of which the following is a specification.

In many manufacturing operations where retorts, furnaces and the like are subjected to a high temperature it is desirable to employ iron or other similar relatively cheap and plentiful metal as the retort or furnace material. For example, in the manufacture of coal gas, oil gases and in certain processes employed to effect the fixation of atmospheric nitrogen and in numerous other processes not necessary to be mentioned, iron retorts or furnaces would be highly desirable were it not for the fact that the corrosion or oxidation of the retort or furnace is quite rapid at the rather high temperatures required in these processes. The rapid deterioration and destruction of retorts or furnaces consisting of iron or other similar metal involves in many cases a prohibitive maintenance cost and a consequent or necessary elimination of iron as a furnace material for such purposes.

I have discovered that by properly treating the iron; that is, by providing it with a coating of material which is practically unaffected by or which offers substantial resistance to the corrosive or oxidizing action of the gases which are generated in a retort or furnace, I am enabled to protect such iron or other similar suitable metal to a very great extent if not entirely against the corrosive action of such gases. As a result the life of the retort or furnace is greatly prolonged, thereby reducing the up-keep expense of the same to a point at which the use of iron and such other similar metals as may be found to be practicably suitable for retort or furnace material becomes commercially feasible.

My invention comprehends the idea that all parts of the surface of the retort or furnace with which the retort or furnace gases contact shall be coated over in a proper manner with a metal or metal alloy which offers substantial resistance to the corrosive or oxidizing action of the retort or furnace gases.

I have found that an alloy of nickel and chromium in the proper proportions with or

without the addition of relative small quantities of other metals serves very well as such a protective coating for a retort or furnace of iron.

The principal object of my invention is to provide the iron or other similar corrodible material which may be employed for the construction of retorts or furnaces to be employed for the purposes previously stated with a coating of metal which will offer substantial resistance to the corrosive action of the retort or furnace gases, such coating to be applied directly to and intimately combined with the portions of the surface of the iron of the retort which, but for the presence of the coating, would be acted upon by the said gases.

I have discovered that an alloy of nickel and chromium in the proper proportions with or without the addition of smaller quantities of other metals serves very well as a protective coating for an iron retort or furnace. Such alloy may consist of 85% nickel and from 10 to 15% chromium, the variations in the latter depending upon the amount of impurities which may be present such, for example, as iron, manganese and carbon. I have also found that an alloy consisting of approximately 50 to 60% of nickel, 10 to 20% of chromium and 10 to 30% of iron may be employed. Such alloys as the foregoing offer substantial resistance to the corrosive or oxidizing action of the retort or furnace gases.

I propose to form the coating of the character above described upon the iron or similar metal of the retort by projecting the coating material in the form of very finely divided or atomic-like particles with great force against the surface to be coated. These particles may be in a molten state and sprayed by means of any known form of atomizing device against the surface to be coated or the said coating metal may be converted in any suitable manner into fine particles and propelled with such speed and force against the surface to be coated that upon the striking of the particles against the surface to be coated the kinetic energy is converted partly into mechanical work and partly into heat so that the finely divided particles are not only intimately combined and connected with the surface portions of the metal of the retort to be coated but the particles themselves are overlapped, inter-

mingled, and welded together so that a uniform, dense and compact coating upon the surface of the iron retort is produced.

This coating in effect practically is integral with the iron or other metal of which the retort is constructed. The said coating, together with the relatively heavy sheet metal to which it is applied may be regarded and considered as a single integral metallic sheet.

The combining of the minute particles of an alloy comprising nickel and chromium with each other and with the iron or other similar metal of the retort provides a novel article of commerce; viz, a retort comprising or consisting of a base metal portion, as iron, and an integral coating of an alloy comprising nickel and chromium as stated. Such an alloy having the characteristic of offering substantial resistance to the corrosive and oxidizing action of the retort or furnace gases and its application as a coating to the required portion or portions of the surface of an iron retort or furnace being feasible I am enabled to employ commercially retorts or furnaces made of iron or

other similar metal which is readily corroded and oxidized by the action of the retort or furnace gases.

I claim:—

1. A retort adapted for use in the manufacture of alkali metal cyanide and to be subjected to the action of oxidizing gases at high temperature, the retort comprising a body of ferrous metal which is corrodible by said gases and a protecting skin coating applied to the outer surface of the body and consisting of a base metal alloy which resists the oxidizing action of said gases.

2. A retort adapted for use in the manufacture of alkali metal cyanide and to be subjected to the action of oxidizing gases at high temperature, the retort comprising a body of ferrous metal which is corrodible by said gases and a protecting skin coating applied to the outer surface of the body and consisting of a nickel-chromium alloy which resists the oxidizing action of said gases.

In testimony that I claim the foregoing as my invention, I have hereunto signed my name this 9 day of October, A. D. 1917.

FLOYD J. METZGER.

boiling-point hydrocarbons appear to be produced than if the cracked hydrocarbons be immediately fractionated.

To perform my process I have provided a suitable apparatus and, though it is to be understood that the process may be effected by other apparatus, for convenience in describing the process the apparatus which I at present prefer to employ is illustrated in the accompanying drawings, in which—

Figure 1 is a more or less diagrammatic elevation, partly in section, of the apparatus; and

Fig. 2 is a sectional elevation on line indicated by x^2-x^2 , Fig. 1.

The apparatus illustrated in the drawings is constructed as follows: In a furnace A there is provided a suitable lower combustion chamber 1 having at one end thereof a burner 2 and having at its opposite end an opening 3 through which the products of combustion can pass into a coil-heating chamber 4. In the coil-heating chamber 4 is a cracking coil 5 which is heated by the products of combustion that pass through the chamber 4. The coil-heating chamber 4 is provided at the end opposite that having the opening 3 with an opening 6 through which the products of combustion escape into an upper combustion chamber 7 provided at one end with a burner 8. Thus the chamber 7 is not only heated by the products of combustion from the burner 2 but may be heated additionally by fire from the burner 8.

From the combustion chamber 7 the products of combustion flow through an opening 9 into an intermediate coil-heating chamber 10 having a pre-heating coil 11. The products of combustion flow from the chamber 10 through an opening 12 into an upper coil-heating chamber 13 in which is positioned a heating coil 14. From the chamber 13 the products of combustion discharge through a flue 15. The fuel furnished to the burners 2, 8 may be gas or oil and the burners are capable of raising the various chambers to the temperatures required for performing the process.

The coils 5, 11 comprise a number of straight tubes 16 which pass through perforations 17 in the front and rear walls of the chambers 4, 10. The coils 5, 11 further comprise headers 18 connecting the ends of adjacent tubes to one another. The headers 18 are provided with removable plugs 19. Thus it is clear that the coils 5, 11 may be readily cleaned when such cleaning becomes necessary or desirable. The outlet end of the coil 5 is provided with a pyrometer 20 so that the temperature of said coil and its contents may be noted from time to time during the operation of the apparatus. The outlet end of coil 5 is connected by a tube 21 to a "digester" or combined cracking cham-

ber and carbon catcher 22, preferably of larger cross sectional area than the cracking tubes 16. The cracking chamber 22 may be formed of a piece of relatively large tubing and removable heads 23 are fitted to the opposite ends of the tubing to form tight closures therefor. The heads 23 are detachably held in place by yokes 24 and screws 25.

The cracking chamber 22 is connected by a tube 26 to a heat interchanger 27, said tube 26 being connected with the inner tube 28 of the interchanger. The outer tube 29 of the interchanger is connected by tubing 30 to one end of the coil 14 and the opposite end of said coil is connected by tubing 31 to one end of the coil 11. The outlet end of the coil 11 is provided with a pyrometer 32 so that the temperature of said coil and its contents may be readily observed at intervals. The outlet end of the coil 11 is connected by tubing 33 to the opposite end of the coil 5 from that provided with the pyrometer. The outer member 29 of the heat interchanger is connected by tubing 34 with a pump 35 which receives liquid hydrocarbons through a supply pipe 36 connecting with a tank 37. The tubing 34 is provided with a pressure gage 38.

The inner tube 28 of the heat interchanger is connected by tubing 39 to one or more fractionating stills 40 of any desired construction. When more than one still is employed the stills are connected to one another by cross-overs 41 for continuous operation. If so desired each still may be operated independently of the other, each receiving its supply of oil from 39 through the valve 43, the cross-overs 41 being blanked off. The tubing 39 is provided with a valve 42, and between said valve 42 and the valve 43 with a pressure regulator and discharge valve 44, said pressure regulator serving to keep the requisite pressure on the liquid hydrocarbons in the cracking coil 5 and cracking chamber 22 and also in all other parts of the apparatus between the pressure regulator and the pump 35. Each still 41 is connected by tubing 45 to a condenser 46 and each condenser is connected by a tube 47 to a gas trap 48. Each gas trap 48 is connected by tubing 49 to a gas absorber 50 and the gas absorbers are provided with gas vent pipes 51 to carry the gas to any desired place. Each gas trap 48 is connected by a tube 52 to a sampling box 53 and each sampling box is connected by tubing 54 to a storage tank 55. One or more of the storage tanks 55, in this instance two of them, are connected by tubing 56 to the tubing 36. The tubing 56 is provided with valves 58 and the tubing 36 is provided with a valve 59.

The tubing 39 is connected by tubing 60 with a cooler 61 which in turn is connected by tubing 62 to a gas trap 63. The tubing

UNITED STATES PATENT OFFICE.

JOHN C. BLACK, OF BEVERLY HILLS, CALIFORNIA.

PROCESS FOR THE PRODUCTION OF LOW-BOILING-POINT HYDROCARBONS.

1,426,813.

Specification of Letters Patent. Patented Aug. 22, 1922.

Application filed December 12, 1919. Serial No. 344,406.

To all whom it may concern:

Be it known that I, JOHN C. BLACK, a citizen of the United States, residing at Beverly Hills, in the county of Los Angeles and State of California, have invented a new and useful Process for the Production of Low-Boiling-Point Hydrocarbons, of which the following is a specification.

This invention relates to the dissociation or conversion of high boiling-point hydrocarbons derived from crude petroleum or its equivalent, into those of lower boiling-point, and to a process especially useful in increasing the production of, so termed, gasoline from relatively heavy hydrocarbons having high boiling points. It is known that by the processes at present employed for producing gasoline without cracking, a comparatively small percentage, from a fraction of one percent to thirty percent or more gasoline, is obtained by ordinary distillation of the crude oil.

The processes commonly in vogue for producing gasoline, other than that produced by ordinary distillation of the crude oil, rely fundamentally upon heating the hydrocarbons to certain temperatures under pressure to produce cracking, taking the vapors off at a high temperature under the pressure employed and condensing the same. As distinguishing fundamentally from such pressure-vapor processes, my present process, for brevity, may be termed a pressure-liquid process, since I do not vaporize the hydrocarbons while at cracking temperature but, rather, maintain a pressure on the hydrocarbons above the vapor pressure thereof at the cracking temperature employed whereby the deposited products of decomposition will be in a condition easily removable from the apparatus. I then reduce the temperature of the whole body of hydrocarbons to such a point as may be desirable for the subsequent treatment. If the hydrocarbons are reduced to normal temperature they will have the appearance of crude oil with many of its characteristics and they may be termed a "crude equivalent."

In this improved process I not only maintain pressure on the hydrocarbons under treatment to prevent any material vaporization thereof, but I preferably maintain them at cracking temperatures while in liquid form for a prolonged period of time and retard flow of the liquid hydrocarbons while at cracking temperature so that dissociation

and polymerization will be as complete as possible before the hydrocarbons are cooled or subjected to the subsequent treatment required to separate the low boiling from the high boiling point hydrocarbons. I maintain pressure on the hydrocarbons under treatment until they are cooled if the immediate object is to crack and store the product for subsequent treatment as hereinafter described. If, however, it is desired to crack and then immediately distill, pressure is maintained on the hydrocarbons under treatment during the cracking, dissociation and polymerization of the hydrocarbons, after which distillation of the hot hydrocarbons at atmospheric or higher pressure will be effected in any suitable distilling and fractionating apparatus, two examples of which will be described hereinafter.

To maintain the hydrocarbons at cracking temperatures for the prolonged period of time and at the same time to cause the deposition of carbon produced by the cracking operation, I preferably reduce the speed of flow of the hydrocarbons while they are at the cracking temperatures and, in this particular instance, I accomplish this by discharging the heated hydrocarbons from the cracking or heating coil into a "digester" or cracking chamber of larger cross sectional area than that of the cracking coil tubes, by maintaining the pressure on the hydrocarbons I prevent vaporization and the carbonaceous products of reaction are deposited in a condition easily removable from the apparatus.

In the practice of my process, I may treat for the production of gasoline the intermediate "cuts," resulting from first subjecting crude petroleum or a crude equivalent to any of the heretofore known distillation processes. By such first distillation process there may result, for example, gasoline amounting in volume to from 15 to 20 percent, more or less; asphalt, coke and the like, 20 percent; and intermediates, 65 percent, more or less. The percentages given are only approximate and may vary considerably with petroleum from different localities. These intermediates, when subjected to my process, are changed into a "crude equivalent" which is then fractionated at once to separate the fractions or "cuts" desired, or allowed to stand in storage for a time and then fractionated. When thus allowed to stand in storage, before fractionating, larger amounts of the low

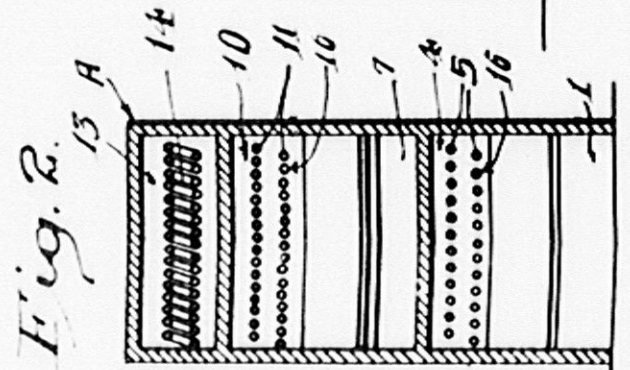
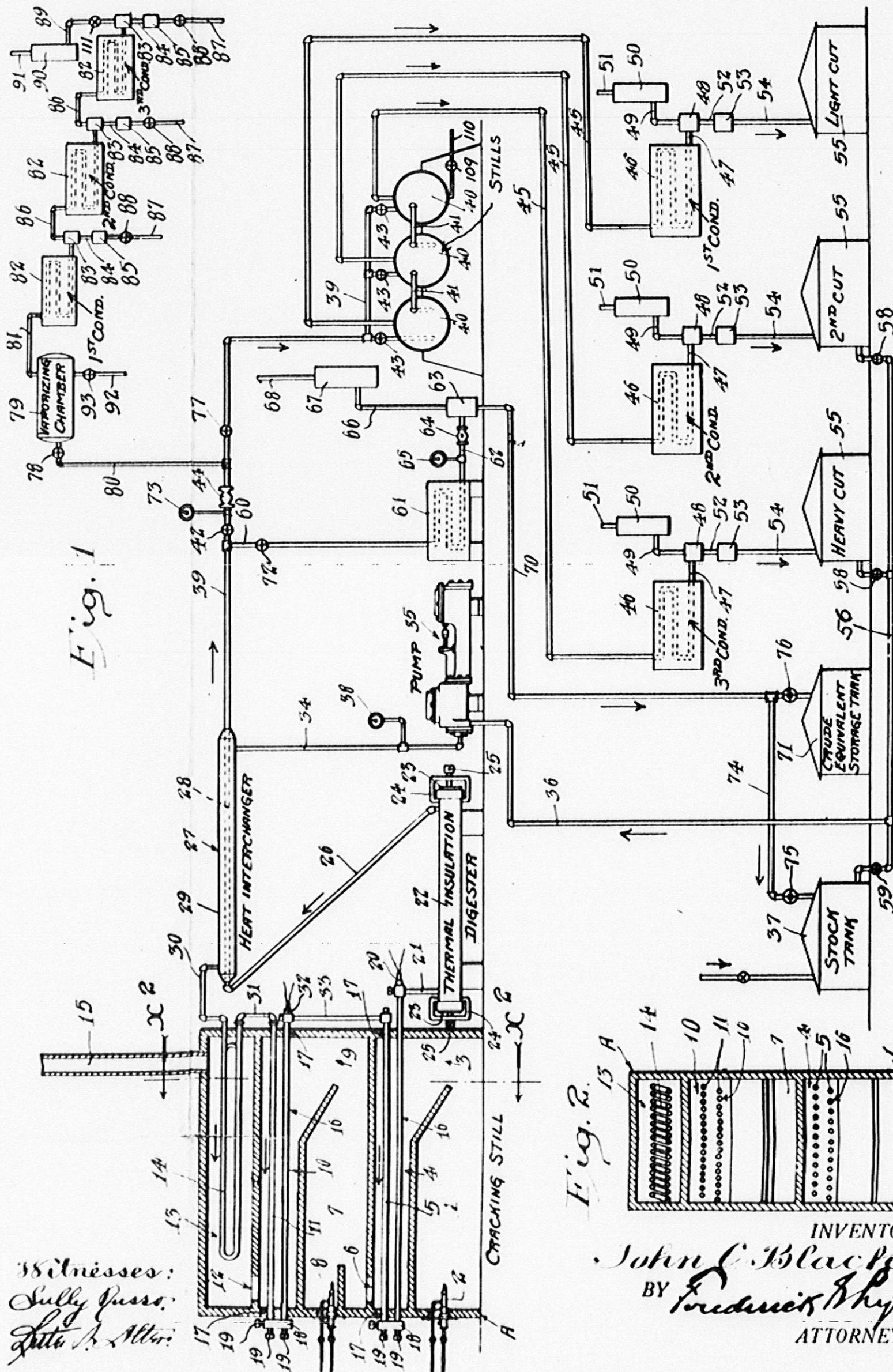
J. C. BLACK.

PROCESS FOR THE PRODUCTION OF LOW BOILING POINT HYDROCARBONS.

APPLICATION FILED DEC. 12, 1919.

1,426,813.

Patented Aug. 22, 1922.



INVENTOR.

John C. Black
BY *Fredrick Rhyer*
ATTORNEY

BY

Fredrick Rhyer
ATTORNEY

ATTORNEY

62 is provided with a pressure regulator 61 and a pressure gage 65 between the pressure regulator and the cooler. The gas trap 63 is connected by tubing 66 to a gas absorber 5 67 and the gas absorber is provided with a gas vent tube 68. The gas trap 63 is connected by tubing 70 to a storage tank 71. The tubing 60 is provided with a valve 72 and the tubing 39 is provided with a pressure gage 73. To the tubing 70 is connected 10 a tubing 74 having a valve 75, and the tubing 74 connects with the tank 37. The tubing 70 is provided between the tubing 74 and the tank 71 with a valve 76.

15 The process is performed in the above described apparatus as follows: The tank 37 will be supplied with the hydrocarbons to be treated. Crude petroleum or a crude equivalent may be employed, but I preferably use the intermediate fractions resulting 20 from treating crude petroleum or a crude equivalent by prior known processes. Among such intermediate fractions, for example, are those which are not capable of 25 being further cracked by the relatively low-pressure processes to produce the much desired low boiling-point hydrocarbons. The valves 59, 72 and 75 are opened and valves 42, 58 and 76 are closed and the pump 35 is 30 operated to force liquid hydrocarbons from the tank 37 through the system and to produce a pressure of several hundred pounds in that portion of the system between the pressure regulator 64 and the pump thus insuring that said portion is entirely filled 35 with the liquid hydrocarbons which are to be treated. The fires are then started at the burners 2, 8 so as to heat the coils 5, 11, 14 to the required temperatures.

40 The pump is continued in operation and the hydrocarbons circulate continuously. Until cracking has taken place to a satisfactory degree the oil is bypassed through valve 75 and tubing 74 to tank 37 to be re-run. The 45 pyrometers 20, 32 will be consulted to determine the temperature of the hydrocarbons in the coils 5, 11. The temperature of the coil 11 will be preferably maintained just under that required for cracking of the hydrocarbons, though if the temperature 50 should rise higher and an incipient cracking of the oil take place the tubes may be readily cleaned of carbon deposits when they become choked. The coil 5 is heated to a predetermined cracking temperature. 55

The degree of pressure employed is predetermined for the particular hydrocarbons being treated. The temperature required for the particular hydrocarbon being treated 60 may be determined by the increase of Baumé gravity of a sample, supplemented usually by a distillation test to determine the yield of hydrocarbons boiling between certain specific temperature limits.

65 Assuming that one or more of the stills 40

is to be utilized, that the predetermined cracking temperature has been reached, and that the regulator 44 has been set for the predetermined operating pressure, the valves 42, 43 will be opened and the valves 78, 72 70 will be closed, thus causing the hydrocarbons to flow into the still or stills when the desired degree of cracking is reached. The pump 35 is continued in operation so as to maintain the desired pressure rearwardly of 75 the pressure regulator 44 and so as to cause the hydrocarbons to flow under such pressure through the various coils and through the cracking chamber 22. The pressure prevents vaporization in the cracking coil 5 and 80 cracking chamber 22. Before the hydrocarbons discharge from the cracking coil 5 they reach the cracking temperature and the time of subjecting the hydrocarbons to the cracking temperature is prolonged by reason of 85 the hydrocarbons discharging from the coil 5 through the tubing 21 into the cracking chamber 22. In the cracking chamber 22 the rate of flow of the hydrocarbons decreases because of the relatively large cross 90 sectional area of the cracking chamber. The cracking chamber 22 is suitably insulated against loss of heat and thus the hydrocarbons are maintained at cracking temperature during the flow of the hydrocarbons 95 through the cracking chamber.

Not only does the cracking chamber prolong the cracking operation so as to insure that the cracking of the hydrocarbons at the given temperature is complete, or substantially complete; but deposition of carbon occurs in the cracking chamber to a much larger extent than in the coil 5, for the reason that the flow of hydrocarbons is slower in the cracking chamber than in the coil 105 5, thus permitting the free carbon produced in the cracking operation to become attached to the relatively large wall area of the cracking chamber.

From the cracking chamber 22 the 110 cracked hydrocarbons, still at comparatively high temperature, flow through the heat interchanger 27 where they are cooled to a greater or less degree, depending upon the area of the radiating surface of the heat 115 interchanger. The heat is absorbed in the interchanger by the cooler hydrocarbons being fed into the system by the pump 35. Thus the heat interchanger serves to initially heat the hydrocarbons being treated and further 120 heating of the hydrocarbons is effected, between the heat interchanger and the coil 11, in the coil 14 around which flow the hot waste gases passing from the chamber 10 through the chamber 13 to the flue 15. 125

The cooling capacity of the interchanger 27 may be such as to cause those hydrocarbons which are liquids at ordinary temperatures and pressures to remain liquid when the artificial pressure is removed. That is to 130

say, if it is not desired to immediately fractionate the cracked hydrocarbons, they may be discharged into the tank 71 by opening the valves 72, 76 and closing the valve 42; that, if the cooling capacity of the interchanger 27 be sufficient, the lighter as well as the heavier hydrocarbons in the crude equivalent will discharge as liquids without running them through supplemental cooling means; and that, if the cooling capacity of the interchanger is not sufficient to prevent vaporization of the cracked hydrocarbons when release of the pressure occurs through the valve 64, then the cooler 61 will be operated to complete this cooling operation. I have discovered that, by allowing the crude equivalent to stand for a more or less extended period of time to permit of further polymerization in the tank 71 before fractionating, upon subsequently fractionating the crude equivalent it yields a greater percentage of the more stable lighter hydrocarbons desired, hence the advantage of immediately cooling the cracked hydrocarbons to a temperature sufficiently low to prevent vaporization of all of them and produce the mixture which is termed a "crude equivalent". When, however, the valve 42 is open and valves 72, 76 closed, the hydrocarbons are treated at once in the still and hence it will not be necessary or desirable to cool them to ordinary temperatures, and consequently less fuel will be required in the stills 40 to effect distillation. If it be not desired to effect cooling of the cracked hydrocarbons by operation of the heat interchanger 27 the incoming hydrocarbons may be by-passed in a manner easily understood.

The hydrocarbons after parting with at least some of their heat in the interchanger 27 will discharge into the first still 40 and the vapors will be carried over into the associated condenser 46. If continuous distillation is employed the unvaporized hydrocarbons will flow from the first still into the second still through the cross over 41 and another cut will be made and the vapors will discharge into the associated condenser. Also from the second still the unvaporized hydrocarbons will discharge into the third still through the cross over 41 and the vapors taken off from the third still will discharge into the associated condenser 46. Whatever gas remains after the vapors pass through the condensers will pass into the absorbers 50 and may be recovered in part in a manner well understood in the art to which this invention relates. To achieve the distilling just described the stills will, of course, be progressively heated from left to right.

The condensates pass from the condensers 46 through the tubing 54 into the storage tanks 55. In this instance, the lighter or lower boiling point hydrocarbons, which it is the desire of the refiner to recover, are

given off in the first still, and the intermediate fractions in the second and third stills and the carbonaceous matter or residue is deposited in the third still. It may be assumed, for example, that the condensed vapor from the first still is approximately 56 Baumé, that the condensed vapor from second still is approximately 35 Baumé and that the condensed vapor from the third still is approximately 20 Baumé. These heavier products or intermediate fractions produced in the second and third stills will be discharged from time to time from the storage tanks 55 containing them through the pipe 56 into the pipe 36 by opening the valves 58 and closing the valve 59, thus permitting the pump 35 to force the intermediate fractions again through the coils 5, 11, 14 and cracking chamber 22 to be re-cracked. The intermediate fractions from the second and third stills 40, however, may be re-run independently through any suitable still for redistillation so as to separate the lighter fractions from the heavier, and such lighter fractions may then be thrown in with the distillate from the first still and the heavier fractions may be stored and then re-run through the apparatus.

If it be not desired to distil the cracked hydrocarbons at once, the valves 42, 75 will be closed and the valves 72, 76 opened, and the cracked hydrocarbons will then flow from the tubing 39 through the tubing 60 into the cooler 61. This cooler 61 may be dispensed with if the heat interchanger 27 is made of sufficiently great cooling capacity to absorb substantially all of the heat artificially applied to the hydrocarbons. The cooler hydrocarbons pass from the cooler 61 through the tubing 62 and pressure regulating valve 64 into the separator 63 and the liquid hydrocarbons flow from said separator through the tube 70 into the storage tank 71. The hydrocarbons in the storage tank 71 may be termed a crude equivalent since it resembles to a large degree crude petroleum. This crude equivalent at any desired time after its production will be fractionated to segregate the low boiling-point hydrocarbons desired from those of higher boiling-point.

Though the above described process differs considerably from the process of refining crude petroleum oil patented to George L. Benton May 25, 1886, No. 341,564 and, though said Benton process was conceived for the purpose of producing a different product, namely an illuminating oil, than this new process, I employ the relatively high temperatures and pressures of the Benton process in the cracking operation; but, instead of spraying the hydrocarbons at cracking temperature into a vaporizing chamber to produce the homogeneous illuminating-oil of the Benton process, I effect a prolonged cracking operation under pressure,

then reduce the rate of flow of the liquid hydrocarbons while at cracking temperatures, then reduce the temperature of the cracked hydrocarbons to or below the vaporizing temperature of the low boiling-point hydrocarbons which it is desired to recover, and finally fractionate the hydrocarbons thus reduced in temperature.

I have discovered that the yield of low boiling-point hydrocarbons is very materially increased by prolongation of the heat and pressure necessary for cracking, and I obtain this prolongation in the apparatus illustrated by use of the cracking chamber 22, which also, as has been noted, reduces the rate of flow of the liquid stream. However, the prolonged cracking temperature and pressure may be obtained by any other suitable means. In this manner I am enabled to produce a greater volume of low boiling-point hydrocarbons from a given quantity of crude petroleum or a crude equivalent than is possible by prior known processes. For this reason the process is very useful and valuable since the production of low boiling-point hydrocarbons such as gasoline by present known processes can scarcely keep pace with the increasing demands therefor, mainly as fuel for internal combustion motors. Also by prior known processes there is produced an over supply of intermediate fractions which I am enabled by this process to crack to produce high grade gasoline, and I prefer to treat such intermediate fractions rather than crude oil because the prior distillation removes a large amount of carbonaceous material which thus cannot act to foul the apparatus. Such intermediate fractions cannot be readily converted into high grade gasoline by the processes now employed in the art.

The hydrocarbons of relatively high boiling-point produced in the second and third stills, in this instance, will be preferably re-run through the apparatus and cracked by my process, and for this purpose, when quantities of the relatively high boiling-point hydrocarbons have been produced by the still, the valve 59 will be closed and the valves 58 will be opened to permit the pump 35 to force such hydrocarbons through the system for cracking and redistillation. From this it is clear that the process may be a continuous one, not only in the sense that new supplies of oil are constantly being treated by the process, but that a relatively large proportion of the product is re-run from time to time to re-crack the relatively high boiling point hydrocarbon previously produced in the apparatus, thus enabling the production of possibly 50 per cent or more of low boiling point hydrocarbons from the original oil treated.

The cracking operation is continued in the coil 5 and cracking chamber 22 until the

increasing differential pressure between the gages 38, 73 or 38, 65 as the case may be, denotes such increased resistance to the flow of the oil as to indicate that said coil or cracking chamber is seriously fouled with carbon, rendering the apparatus inoperative; whereupon the fires are shut off and the fouled tubes 16 and chamber 22 are cleaned, the cleaning operation being facilitated by removal of the plugs of the headers and the heads 23 of the cracking chamber thus to allow each tube and the cracking chamber to be separately cleaned of the carbon deposited therein.

The higher the temperature and longer the time employed for cracking the hydrocarbons the larger will be the yield of low boiling-point hydrocarbons and the greater will be the production of carbon, so that in a practical commercial plant it is necessary for the operator to choose such a temperature and pressure and duration of such temperature and pressure that as long a run as possible may be made, without the necessity of cleaning out the carbon, consistent with a sufficient yield of gasoline to make the operation of the plant profitable.

The process may be better understood by a specific example as follows:

I have operated with my process on an oil that begins to crack at about 750° F. but producing a low yield of gasoline. By heating this oil to about 800° F. the yield of gasoline was increased, and by heating the oil to 850° F. or as high as 900° F. the yield of gasoline was as high at 30% of the original stock employed. This latter temperature may be too high in practice to make the process profitable and the refiner might have to be contented with a lower yield but longer running time, the decreased cost of operation of the longer running time compensating for the lower yield.

It is of paramount importance that the pressure employed in this process be sufficiently high to prevent vaporization of the oil in the tubes 16 excepting possibly to an inconsiderable and negligible degree, since such vaporization would cause rapid deposition of carbonaceous material in the tubes and consequent quick fouling thereof. In practice I have successfully employed, and prefer a pressure of not less than 35 atmospheres and as high as 1000 to 1200 pounds per square inch and even higher for some oils. The pressure to be employed is dependent in a great measure upon the character of the oil being treated and the temperature to which the oil is subjected in the cracking operation, since the higher the temperature employed the greater the pressure required to prevent any substantial vaporization of the oil.

It is to be noted that the reduction in temperature of the cracked hydrocarbons to

or below the vaporizing temperature of the low boiling-point hydrocarbons which it is desired to recover enables me to avoid the production of a homogeneous vapor such as that made by Benton in his production of illuminating-oil. Benton's process enabled him to increase the production of illuminating-oils and decrease the production of benzine, while my process the production of gasoline is increased and that of the less valuable intermediate fractions is decreased. This result is effected in the apparatus shown by employing cracking temperatures of from 750° F. to 1200° F., or even higher for some oils, and pressures in excess of 60 atmospheres.

The apparatus shown in the drawings and described above is not claimed herein but is the subject of my copending application. Instead of fractionating the cracked hydrocarbons in the stills 40, I may fractionate them by running them through fractional condensers and for this purpose I have shown in the drawings a distillation vaporizing chamber 79 which is connected by tubing 80 to the tubing 39 between the pressure regulating valve 44 and a valve 77 on the tubing 39. The chamber 79 is connected by tubing 81 with the first of a series of fractional condensers 82, the coils of which discharge into gas or vapor traps 83. The gas traps are connected by tubes 84 with sampling boxes 85. The vapor trap 83 of the first condenser is connected with the coil of the second condenser, and the vapor trap of the second condenser is connected with the coil of the third condenser by tubings 86. Each of the sampling boxes 85 is connected by tubing 87 to a suitable receptacle or tank, the tubes 87 being provided with valves 88, respectively. For example, the discharge pipe 87 of the first condenser 82 may be considered as being connected with the first tank 55 beginning at the left in Fig. 1 of the drawings, the tubing 87 of the second condenser as being connected with the second tank 55, and the tubing 87 of the third condenser as being connected with the tank 55 at the right side of Fig. 1. These connections with the tanks 55 are not shown since it would tend to congest the drawing to show them, but it is understood such connections exist so that the heavier and lighter intermediate fractions from the first and second condensers 82 may be readily re-run through the apparatus for re-cracking in a manner hereinbefore described. The gas trap of the third condenser is connected by a tube 89 with a gas absorber 90 provided with a vent pipe 91. A pipe 92 having a valve 93 discharges from the chamber 79.

In order to fractionally condense the cracked hydrocarbons, the valve 77 on the tubing 39 will be closed, as well as the valve

72, and the valve 78 will be opened, thus allowing the hot liquid hydrocarbons discharging through the pressure regulator 44 to vaporize in the chamber 79. The tarry products or other carbonaceous matter thrown down in the chamber 79 may be drawn off through the pipe 92. It is understood that the temperature of the liquid hydrocarbons in the tubing 39 and connecting tubing 80 will be sufficiently high under the pressure employed to cause the vaporization of the desired distillates, which in turn are fractionally condensed in the condensers 82. The hot vapors pass from the chamber 79 into the first condenser 82 which will be made of such cooling capacity as to condense the heavier intermediate hydrocarbons that will then flow to the appropriate tank. The uncondensed vapors will pass from the first gas trap 83 through the tubing 86 into the second condenser which will be of such cooling capacity as to condense the lighter intermediate fractions. These lighter intermediate fractions will then discharge from the associated vapor trap 83 and pass to the appropriate tank and the uncondensed lighter vapors will pass over into the third condenser through the associated tubing 86. The third condenser will be of sufficient cooling capacity to cause condensation of the low boiling-point fraction which it is the desire of the refiner to produce and such fractions will discharge from the associated vapor trap 83 and pass to the appropriate tank. The gas may pass from the third gas trap through the tubing 89 into the gas absorber 90 where certain low boiling-point fractions may be recovered, in a manner well understood in the art to which this invention relates.

It is understood that redistillation and re-running through the apparatus of the intermediate fractions thus resulting may be effected in the same manner as above described for the fractions produced by the stills 40. The same cuts or fractions may be produced in the series of condensers 82 as are produced by the stills 40. It is understood that the cooling capacity of the heat interchanger 27 or any other suitable cooling means may be such that the temperature of the liquid hydrocarbons will be reduced from that required for cracking to that which will produce in a single vaporizing and condensing operation the low boiling point fraction desired; or that after such cooling the temperature will be reduced only enough to produce by evaporation and fractional condensation the lighter fractions and one or more of the intermediates above referred to or the pressure may be so regulated by valves in the exits of the fractionating apparatus and the reducing valve 44 as to permit of the vaporization of those fractions whose vapor tension is in excess of the pres-

sure maintained in chamber 79. The remaining uncondensed vapors will then be condensed as above described to produce the low boiling-point fraction desired. Though the various fractions may be produced by the fractional condensing described above, there may be, in practice, advantages in fractionating the hydrocarbons by the fractional distillation operations previously described but the ultimate result is the same which ever fractionating operation is employed.

I claim:

1. In the process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons in coils to a temperature sufficient to crack them and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, precipitating the carbonaceous material of reaction after the hydrocarbons leave the coils, maintaining therein a pressure sufficient to prevent vaporization, substantially maintaining the hydrocarbons in their highly heated condition to permit of their substantially complete vaporization upon release of pressure, releasing the pressure and discharging the vaporized hydrocarbons into a cooling system and stepping down their temperature to fractionally condense them.

2. In the process for the production of low boiling point hydrocarbons, the combination of steps consisting in heating the hydrocarbons to a temperature sufficient to crack them and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing the rate of flow of the hydrocarbons without any material reduction in pressure and temperature to permit of further reaction and polymerization, and then reducing the temperature of the cracked hydrocarbons while under this pressure to a degree sufficient to prevent vaporization of the low boiling-point hydrocarbons when they are discharged at atmospheric pressure.

3. In the process for the production of low boiling-point hydrocarbons, the combination of steps comprising heating the hydrocarbons to a temperature sufficient to crack them and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, and then reducing the rate of flow of the hydrocarbons without any material reduction in pressure and temperature to permit of further reaction and polymerization.

4. A process for cracking hydrocarbons comprising forcing the hydrocarbons through heating tubes at a temperature sufficient to crack them and at a pressure of not less than 35 atmospheres to prevent the vaporization thereof, decreasing the rate of flow of the hydrocarbons after leaving the heating tubes and maintaining the hydrocarbons at a cracking temperature and under

pressure sufficient to prevent vaporization thereof and finally discharging the hydrocarbons from the apparatus.

5. In the process for the production of low boiling point hydrocarbons, the combination of steps consisting in heating the hydrocarbons in a single passage to a temperature sufficient to crack them and under pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing their rate of flow, and then reducing the pressure and vaporizing the hydrocarbons separating fractions heavier than gasoline and returning said fractions to the cracking apparatus.

6. In a process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons to a temperature sufficient to crack them and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing the temperature of the cracked hydrocarbons while under said pressure, then reducing the pressure of the cracked hydrocarbons, then immediately stepping up the temperature of all of the cracked hydrocarbons to vaporize the hydrocarbons of different boiling-points and then separately cooling the vapors of different boiling points.

7. A process of cracking hydrocarbons which consists in passing the hydrocarbons through heating tubes, subjecting them to a temperature sufficient to crack them and under a pressure and not less than 35 atmospheres to prevent the hydrocarbons from vaporizing. Passing the hydrocarbons along at a reduced rate of flow and maintaining the cracking temperature, also maintaining the pressure sufficiently high to prevent the hydrocarbons from vaporizing and then cooling the hydrocarbons while under said pressure to a degree sufficient to prevent vaporization when they are discharged at atmospheric pressure.

8. In the process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons to a temperature sufficient to crack them; by passing them through a heating zone then retarding their rate of flow and maintaining them during a prolonged period of time at a cracking temperature and under a pressure not less than 35 atmospheres to prevent vaporization thereof, and then reducing the temperature of the cracked hydrocarbons while under this pressure to a degree sufficient to prevent vaporization of the low boiling-point hydrocarbons when they are discharged at atmospheric pressure.

9. In the process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons to a temperature sufficient to

crack them and maintaining them at a cracking temperature over a prolonged period of time and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing the temperature of the cracked hydrocarbons while under said pressure, then reducing the pressure sufficiently to permit the lower boiling-point hydrocarbons to vaporize, and then stepping down the temperature of the vaporized hydrocarbons to liquify the lower boiling-point hydrocarbons.

10. In the process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons to a temperature sufficient to crack them reducing their rate of flow and maintaining them at a cracking temperature over a prolonged period of time and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing the pressure sufficiently to permit the lower boiling-point hydrocarbons to vaporize, and then stepping down the temperature of the vaporized hydrocarbons to liquefy the lower boiling-point hydrocarbons.

11. In the process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons to a temperature sufficient to crack them reducing the rate of flow and maintaining them at a cracking temperature for a prolonged period of time and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing the temperature of the cracked hydrocarbons while under said pressure, then reducing the pressure of the cracked hydrocarbons, then stepping up the temperature of all of the cracked hydrocarbons to vaporize the hydrocarbons of different boiling points, and then separately cooling the vapors of different boiling points.

12. In the process for the production of low boiling-point hydrocarbons, the combination of steps consisting in heating the hydrocarbons in a single passage through a furnace to a temperature sufficient to crack them reducing the rate of flow and maintaining them at a cracking temperature for a prolonged period of time and under a pressure of not less than 35 atmospheres to prevent vaporization thereof, and reducing the pressure sufficiently to permit the desired hydrocarbons to vaporize.

13. The process of producing low boiling-point hydrocarbons which comprises the following steps forcing the hydrocarbons through a heating zone under a pressure of not less than 35 atmospheres whereby vaporization of the hydrocarbons is prevented, first through a coil wherein the hydrocarbons are maintained at a temperature near the initial cracking point, then passed

through a coil wherein they are heated above the initial cracking point, then passed through a larger tube wherein the hydrocarbons are kept at a cracking temperature for a considerable length of time to facilitate the conversion thereof to the low boiling point hydrocarbons as described.

14. In the process for the production of low boiling point hydrocarbons, the combination of steps consisting in heating in a single passage through a furnace the hydrocarbons to a temperature sufficient to crack them and under pressure of not less than 35 atmospheres to prevent vaporization thereof; then reducing the rate of flow of the cracked hydrocarbons while under said pressure, then reducing the temperature of the hydrocarbon, then reducing the pressure sufficiently to permit the lower boiling-point hydrocarbons to vaporize and then condensing them.

15. In the process for the production of low boiling-point hydrocarbons, the combination of steps comprising heating the hydrocarbons in tubular coils in a single passage through a furnace to a temperature sufficiently high to crack them, then transferring the hydrocarbons to a chamber of relatively larger cross sectional area compared to the tubular area wherein their rate of flow is materially reduced and maintaining therein and in the series of coils a pressure of not less than 35 atmospheres to prevent vaporization of the hydrocarbons, thereby preventing to a large extent detrimental accumulation of carbonaceous material in the tubular coils and permitting the carbonaceous material to be deposited in the chamber of large cross sectional area from a liquid suspension whereby their accumulation is in a condition easily removable as described.

16. In the process for the production of low boiling-point hydrocarbons, the combination of steps comprising heating the hydrocarbons in a coil to a temperature sufficient to crack them and under pressure of not less than 35 atmospheres to prevent vaporization thereof, transferring the hydrocarbons to a tube or chamber of larger cross sectional area, completely filling the larger tube or chamber with hydrocarbons in a liquid state and passing the hydrocarbons through the larger tube or chamber while still maintaining them under pressure to deposit the carbonaceous matter and finally discharging the undeposited hydrocarbons from the chamber.

Signed at Los Angeles, California, this 10th day of November, 1919.

JOHN C. BLACK.

Witnesses:

GEORGE H. HILES,
L. BELLE WEAVER.

FILED AUG 26 1935

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

In Equity No. 6492.

April Term 1935.

GASOLINE PRODUCTS COMPANY, INC.,
Plaintiff-Appellant,

vs.

CONWAY P. COE, Commissioner of Patents,
Defendant-Appellee.

BRIEF FOR PLAINTIFF-APPELLANT.

SEMMES AND SEMMES,
Solicitors for Plaintiff-Appellant.

NEWTON A. BURGESS,
Of Counsel.

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IN THE
United States Court of Appeals
FOR THE DISTRICT OF COLUMBIA.

GASOLINE PRODUCTS COMPANY, INC.,
Plaintiff-Appellant,

vs.

CONWAY P. COE, Commissioner of
Patents,
Defendant-Appellee.

IN EQUITY
No. 6492.

APRIL TERM 1935.

BRIEF FOR PLAINTIFF-APPELLANT.

For the purpose of brevity throughout the brief, plaintiff-appellant and defendant-appellee will be referred to as plaintiff and defendant.

THIS CAUSE is before the Court under the authority of Section 4915 of the Revised Statutes.

On November 6, 1922, John C. Black filed an application for Heating Coil for Cracking Hydrocarbon Oils, Serial No. 599,403, in the United States Patent Office. This application was duly prosecuted, but the claims were finally rejected by the Examiner on certain patents and an appeal was taken to the Board of Appeals and the Primary Examiner was affirmed.

Believing the Patent Office to be in error in rejecting his claims, Black proceeded in accordance with the well established practice under Section 4915 of the Revised Statutes. The case was tried before his Honor Judge Bailey who, without extended opinion, affirmed the Patent Office. Hence this appeal.

The Claims in Issue.

We give below the claims which were rejected by the Patent Office:

13. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron and chromium alloy, said chromium in the alloy being in such proportions as to substantially prevent the corrosive action of sulphur.

14. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron chromium nickel alloy, said alloy being in such constituent proportions as to substantially prevent the corrosive action of sulphur.

15. An apparatus for cracking hydrocarbons comprising a furnace, a cracking coil positioned within said furnace, said coil being formed of material comprising an alloy of iron and chromium substantially resistant to the corrosive action of sulphur and means in said furnace for supplying products of combustion thereto.

16. An apparatus for cracking hydrocarbons comprising a furnace, a plurality of tubes in said furnace through which the oil to be cracked is passed under pressure, said tubes being formed of an alloy of iron chromium and nickel, substantially resistant to the action of sulphur under the conditions of cracking, and means for passing hot products of combustion over said tubes to crack the oil therein.

It will be apparent from the foregoing claims that each of them is limited to apparatus for cracking petroleum oils and that each calls for a cracking coil substantially resistant to the action of sulphur and com-

posed of an alloy of iron and chromium (claims 13 and 15) or an iron, chromium, nickel alloy (claims 14 and 16).

The patents cited in the answer are as follows:

Palmer	1,268,763	June 4, 1918
Gillespie	1,306,690	June 17, 1919
Kelley	1,365,499	Jan. 11, 1921
Van Steenbergh	1,407,339	Feb. 21, 1922
Metzger	1,422,878	July 18, 1922
Black	1,426,813	Aug. 22, 1922
Black	1,815,428	July 21, 1931.

The only issue presented in this case is whether or not invention was involved in discovering the source of difficulty with the iron or steel cracking tubes universally used before Black, coupled with the discovery that chromium steel alloy or chromium nickel steel alloy tubes would eliminate the inevitable corrosion problem with iron and steel tubes and at the same time present no additional problems.

The Problem Confronting the Industry at the Date of Black's Invention.

The use of tubes in oil cracking stills began about 1915, as stated by Mr. Dixon (Rec., p. 32). It is unnecessary at this time to go extensively into the development of oil cracking, but it is a matter of common knowledge that oil cracking increased very rapidly after Dr. Burton made his eventful discovery that lighter oils could be made from heavier oils by what was termed the cracking process.

Mr. Dixon has also stated that the chemical reactions involved in the cracking operation, as well as the possible chemical reactions between the oil products and the metal of the cracking tubes, are very complex (Rec., p. 33). According to Mr. Dixon, cracking is done at high temperatures of the order of 700° F. to 1050° F.

and under high pressure in the neighborhood of 400 to 600 pounds per square inch (Rec., p. 31). Obviously, it must be accomplished in closed vessels, all of which greatly increases the difficulty of determining exactly what is taking place. One thing soon became apparent to all those who dealt with oil cracking processes and that was that for some unknown reason the metal of the steel or iron cracking tubes was rapidly corroded, or eaten away during the cracking process. The danger to life and property from this source is quite apparent. It soon became one of the real problems of the industry, but it remained unsolved until Black made his invention.

Mr. Dixon has stated that iron and steel cracking tubes were corroded during the cracking operation and that the corrosion was non-uniform (Rec., p. 18) so that one could never tell by external inspection just what the condition of the tube walls was inside the cracking furnace. This meant, of course, that there was a constant fire and explosion hazard which kept the operators on edge at all times. Despite the eternal vigilance of the operators, many fires resulted from bursting tubes. Mr. Dixon has stated that these fires occurred as frequently as once a month and even more frequently (Rec., p. 22). Much property damage was involved in such instances (Rec., p. 21) and sometimes operators were badly burned or killed as a result of these occurrences (Rec., p. 17).

It seems unnecessary to argue the point that if the cause of this trouble were obvious and its remedy apparent, it would not have existed so long without some one supplying the obvious remedy. The mere fact of its continued existence over a period of six or seven years, should be enough to convince anyone that it was not obvious. Otherwise, the industry was most negligent of its own property, to say nothing of the more important question of the loss of human life.

The above is a fair statement of the conditions existing in the oil cracking industry at the time that Black made the invention now before this Court.

The Invention in Issue.

Black's invention consists of two parts:

1. The discovery of the cause of corrosion of the old cracking tubes; and
2. Supplying the remedy.

This case is quite similar to that of *Eibel Co. v. Paper Co.*, 261 U. S. 45, where Chief Justice TAFT stated (p. 68):

“The invention was not the mere use of a high or substantial pitch to remedy a known source of trouble. It was the discovery of the source not before known and the application of the remedy for which Eibel was entitled to be rewarded in his patent.”

Again, Chief Justice TAFT says (p. 63):

“In administering the patent law the court first looks into the art to find what the real merit of the alleged discovery or invention is and whether it has advanced the art substantially. If it has done so, then the court is liberal in its construction of the patent to secure to the inventor the reward he deserves.”

See also:

Consolidated Co. v. Window Glass Co., 261 Fed. 362;
Miehle v. Whitlock, 223 Fed. 647.

The present case meets both of the above conditions of the *Eibel* case, as clearly shown by the testimony of Mr. Dixon. In fact the rule as to *granting* of patents should be even more liberal than the rule for *sustaining* them after being granted.

In re Harbeck, 39 App. D. C. 555.

Having discovered the source of the trouble, Black took the second step and supplied the remedy. Even this could not have been obvious because there is nothing in the case to show that it was known that chromium alloys would resist sulfur compounds under oil cracking conditions. Like so many cases involving chemical reactions, the test was empirical. See

Tyler v. Boston, 7 Wall. 330;

General Electric Co. v. Laco-Philips, 233 Fed. 96;

Naylor v. Alsop, 168 Fed. 911.

Many metals and alloys must have been tried before chromium alloys were discovered as the answer. In view of the numerous advantages secured by Black, it is hard to conceive a case requiring a greater degree of invention than the present.

Oftentimes the discovery of the source of the difficulty is the major part of important inventions. This was the case with Eibel. After the source of the trouble was clearly understood, the remedy was almost obvious. Still the Supreme Court found the patent valid.

In the present case the problem of locating the difficulty was much greater than with Eibel. In oil cracking the whole operation takes place in closed vessels where it is very difficult to find out just what is happening. There are so many chemical reactions possible with the complex hydrocarbons at the high temperatures and pressures used that it is indeed very difficult to find the exact cause of any one reaction. In 1922, this was much more difficult because oil cracking was then in its early stages of development.

If the discovery which Eibel made in the paper making industry was an invention, there would appear to be no question that Black's discovery was also. Of the two, Black's was much the more difficult. It really meant more to the oil cracking industry than Eibel's did to paper making. Eibel's invention meant an increase in

production of only about 40%. Here, according to Mr. Dixon's testimony we have an increase in tube life of at least 500% (Rec., p. 31). This tremendous increase in life is only one of the benefits. The greatest here is the saving in human life and the peace of mind of the operators.

Had it been obvious that chromium alloy tubes possessed all these advantages over the commonly used steel tubes, it is too plain for argument that they would have been adopted long before they were. If the prior art patents contained this information, why did the art wait so long to appreciate it? It is easy now to say that the prior patents disclose this information, but the fact that no one *at that time* gained such information from these patents, is much more persuasive.

It may now seem simple and obvious that chromium alloys would be the logical thing to use, but the history of the art proves the contrary. Under circumstances much less favorable to the inventor the Supreme Court gave the inventor the benefit of the doubt, in *Loom Co. v. Higgins*, 105 U. S. 580. There it was stated (p. 591):

“It may have been under their very eyes, they may almost be said to have stumbled over it; but they certainly failed to see it, to estimate its value, and to bring it into notice. Who *was* the first to see it, to understand its value, to give it shape and form, to bring it into notice and urge its adoption, is a question to which we shall shortly give our attention. At this point we are constrained to say that we cannot yield our assent to the argument, that for combination of the different parts or elements for attaining the object in view was so obvious as to merit no title to invention. Now that it has succeeded, it may seem very plain to any one that he could have done it as well. This is often the case with inventions of the greatest merit. It may be laid down as a general rule, though perhaps not an invariable one, that if a new combination and arrangement of known elements produce a new and beneficial result, never attained before, it is evidence of invention.”

Patents covering inventions involving *one* of the following beneficial features have been sustained, despite the fact that the only *physical* change has been a substitution of one old material for another:

1. New and useful result:

Geo. Frost v. Cohn, 112 Fed. 1009;
In Re Harbeck, 39 App. D. C. 555; 191 O. G. 586.

2. An increase in efficiency:

Geo. Frost v. Cohn, 112 Fed. 1009;
In Re Harbeck, 39 App. D. C. 555; 191 O. G. 586;
Low v. McMaster, 266 Fed. 518.

3. A saving in operation:

Geo. Frost v. Cohn, 112 Fed. 1009.

4. Superior to other materials used:

Smith v. Goodyear Co., 93 U. S. 486;
Low v. McMaster, 266 Fed. 518.

5. Successful where other materials failed:

Yablick v. Protecto, 21 Fed. (2d) 885;
Acme v. Remington, 3 Fed. Supp. 254;
Low v. McMaster, 266 Fed. 518.

6. Different properties from prior materials:

Bridgeport v. Hooper, 1881 C. D. 303;
In Re Harbeck, 39 App. D. C. 555; 191 O. G. 586.

7. Effects a lightening of the burden of the operators:

United Shoe Co. v. Ferree Co., 64 Fed. (2d) 101
 (C. C. A. 2).

8. Increased life:

Fitchburg Co. v. Barrell, 214 Fed. 777.

Mr. Dixon has testified specifically that the alloy of Black has actually accomplished every one of the foregoing eight benefits in the oil cracking art (Rec., pp. 20-21; pp. 30-31). The presence of invention has been overwhelmingly established.

Black's invention also actually protects human life. Mr. Dixon has shown that with steel tubes the operators are always on edge because it is impossible to *know* the condition of the tubes on account of the non-uniformity of corrosion (Rec., p. 18; p. 30). With chromium alloy tubes the operators *know* there is substantially no corrosion. It is easy to understand why the operators are on edge around a steel tube cracking unit when their life depends so heavily on these tubes. It is also easy to understand why the morale of the operators should be so greatly increased when chromium alloy tubes are used because they can then forget the great hazard of tube failures from corrosion.

The Patent Office did not have the benefit of Mr. Dixon's testimony. The Board of Appeals thought that the uses of chromium alloys as given in the cited patents were analogous to that of Black and based their opinion on this ground. Mr. Dixon has shown that they are not analogous (Rec., p. 23; p. 24; p. 26; p. 28; p. 30) and his testimony has not been contradicted. Therefore, the conclusion of the lower court must have been erroneous.

There is absolutely nothing in the record to show that anyone prior to Black appreciated that in oil cracking, sulphur compounds are the trouble makers. Since that was essential to a discovery of the source of the trouble with the old oil cracking tubes, it follows that the patents can not anticipate.

Mr. Dixon has said that 80% of the oil cracking tubes used by the Texas Company at Port Arthur, San Antonio, El Paso and in California since 1928 are made of chromium steel alloy (Rec., p. 20). The statement of Dr. Egloff in a paper read before the Petroleum Institute in December 1927, pays high tribute to chromium steel alloy tubes and no doubt if plaintiff had gone to the ex-

pense of bringing representatives of other oil cracking companies to testify, it would appear that they have also adopted the chromium steel alloy tubes very extensively. The Texas Company may be considered as representative of the industry, and the fact that they have so extensively installed these chromium steel alloy cracking tubes, is certainly the best evidence of their value.

From Mr. Dixon's testimony (Rec., p. 22; p. 23; p. 24; p. 26; p. 27; p. 28; p. 30) it must be apparent to the Court that none of the patents cited in the answer deals in any way with the specific problem which the oil cracking industry faced from 1915 to 1922. The Court below has failed to appreciate Black's invention and because of such failure has rejected his claims. We submit that the lower Court has been guilty of reading into the disclosures of the cited patents after acquired knowledge disclosed in the Black application. The law is well settled that it is not permissible to read into patents and publications information which is not plainly contained or disclosed therein. It is indeed remarkable that the Examiner should have cited six patents as anticipations, none of which even mentions the problem solved by Black. The Examiner must have realized the weakness of the citations or he would not have cited six patents. As stated by the late Judge Hough of the Second Circuit Court of Appeals, "One can not make omelets of bad eggs—no matter how many are used." (*Ball & Roller Co. v. Sanford*, 297 Fed. 163, 167.) This is exactly what the Examiner endeavored to do in this case. All the law is against such action, as shown by the cases discussed below.

The action of the Patent Office and the Court below in holding that the claims are unpatentable over the references cited necessitated reading into the references, in the light of applicant's disclosures, considerably more than the prior inventors intended or even appreciated. Such a practice is universally disapproved by the Courts. See *Loew Filter vs. German-American Filter Company*, 164 Fed. 855, wherein it is said (p. 860):

“It is not competent to read into such a publication information which it does not give, or by expert opinion explain an otherwise uninforming statement by evidence of some apparatus or article not itself competent as an anticipation.”

It is submitted, therefore, that the disclosures read without any amplification do not form an anticipation of the claims.

When a prior patent does not suggest the use of the material for the specific purpose had in view by the applicant, the patent can not be used as a reference. A case particularly in point to this situation is *Munising Paper Company vs. American Sulphide Pulp Company*, 228 Fed. 700 . It is stated (p. 703) that:

“It is obvious that it never occurred to him that cement had in the slightest degree capacity to resist the digesting acid. * * * Prior patents are part of the prior art only by what they disclose on their face. *Naylor vs. Alsop Process Co.* (C. C. A. 8th Cir.) 168 Fed. 911, 920.”

See also *ex parte Aram*, 1926 C. D. 47.

Inventions are to be judged in the light of what the art disclosed or suggested before and not in the light of after acquired knowledge. The Courts look with disfavor upon using after acquired knowledge and in the case of *Commercial Acetylene Company vs. Avery Portable Lighting Company*, 166 Fed. 907, it is stated (p. 911):

“It is a cheap and easy thing to say, *after the fact*, that any skilled chemist might have arrived at the discovery by application of well known physical laws. There are comparatively few patents that could escape this plan of attack.” (Italics supplied.)

Again in the case of the *General Electric Company vs. Mallory and Company*, 294 Fed. 562, it was said (p. 564):

“The defenses in the case at bar might be called synthetic defenses. Once an invention is

disclosed to the world, skilled men can show how, if somebody previously had done this or that, the inventive result would have happened, and the device of the patent could have been built up. But the answer usually is that the prior art shows that the skilled men did not conquer the 'ifs'."

Another case condemning this practice in no uncertain language is the case of *Diamond Rubber Company vs. Consolidated Rubber Tire Company*, 220 U. S. 428, in which the Supreme Court said (p. 434):

"Many things, and the patent law abounds in illustrations, seem obvious after they have been done, and, 'in the light of the accomplished result', it is often a matter of wonder how they so long 'eluded the search of the discoverer and set at defiance the speculations of inventive genius.' "

For other cases along the same line, see *Procter & Gamble vs. Berlin Mills Company*, 256 Fed. 23; *General Electric Company vs. Alexander*, 277 Fed. 290 and *Waterbury Buckle Co. vs. G. E. Prentice Manufacturing Company*, 294 Fed. 930.

The Prior Art Patents.

The patents cited in the answer are:

Palmer	1,268,763
Gillespie	1,306,690
Kelley	1,365,499
Van Steenbergh	1,407,339
Metzger	1,422,878
Black	1,426,813
Black	1,815,428.

The Board of Appeals in affirming the Primary Examiner selected the Metzger patent as representative of the prior art patents and believing that the use which Metzger made of the alloy disclosed in his patent to be

analogous to applicant's use of his alloy, concluded that there would be no invention in the selection of Black's alloy in view of Metzger and the other patents cited.

Of course, the Board of Appeals did not have before it the testimony of Mr. Dixon, which is now before this Court. They were, therefore, uninformed, both as to the true picture of Black's problem and of the utter failure on the part of Metzger and the other patentees cited to face this problem or to effect a solution of it. We do not know the views of the Court below as no opinion was written.

Before discussing the prior art patents individually and in detail, it will be helpful to point out certain broad features which apply to all of the prior art cited and which, in our opinion, alone are sufficient to remove all of them as anticipations of Black's idea.

In the first place, as Mr. Dixon has stated, not a single one of the prior patents cited makes even the faintest reference to corrosion from sulphur compounds (Rec., p. 22; p. 24; p. 26; p. 28; p. 29). So far as one is able to determine from the patents themselves, none of the patentees cited appreciated the fact that there is any such thing as sulphur corrosion because this subject is not mentioned anywhere.

The problem of sulphur corrosion was not presented to anyone of the cited patentees and, therefore, there was no occasion for them to deal with the solution of that problem. We make the foregoing statement despite the fact that the Van Steenbergh patent discloses apparatus for cracking mineral oil to produce gasoline. As we shall show later when we discuss this patent in detail, everything disclosed by Van Steenbergh points to the fact that he accepted corrosion of his cracking tubes as inevitable and made no mention of any problem with sulphur corrosion and, of course, no suggestion as to how such problem might be overcome.

Gillespie, Kelley and Metzger disclose nothing more than methods of making surface alloys. Mr. Dixon

points out very clearly why none of these three surface alloy metals could be used in making oil cracking tubes (Rec., p. 24; p. 25; p. 29).

Palmer discloses means for making natural gas and, therefore, does not face Black's problem at all, nor anything that could properly be compared with it.

The Black patent 1,426,813 is cited apparently merely to show the type of apparatus used prior to the Black invention involved in this suit.

Black patent 1,815,428 deals with a digester for cracking hydrocarbon oils and being by the same inventor involved in this suit and also being a copending application, is considered not to be pertinent as an anticipation. There clearly is no question of double patenting involved and it, therefore, becomes a matter of speculation on our part as to why this patent was cited in the answer.

Before the Court below, the defendant took considerable liberty with the record and in its argument stated in substance that it is known that sulphur corrosion is a very common form of corrosion and that it was common knowledge that chromium alloy steel and chromium nickel steel, which are called stainless steels, are resistant to sulphur corrosion. There is absolutely no evidence in the record, either in the patents cited or in the testimony to support the above statement. If the Commissioner wished to make any such argument, some reference should have been made of record or some testimony should have been taken in support of it. As a matter of fact, the testimony of Dixon very definitely contradicts any such argument (Rec., pp. 18-19).

Referring to the cited patents in detail and taking them up in the order of their number, we will first refer to,

Palmer 1,168,763: Mr. Dixon has pointed out that this patent does not disclose anything tending to show that chromium steel alloy or chromium nickel steel alloy is resistant to sulphur compounds (Rec., p. 22). On the contrary, the use by Palmer of a chromium steel alloy is

for the purpose of preventing oxidation and to resist corrosion from carbide-forming gases (Rec., p. 22). He further points out that there is no similarity between sulphur corrosion and the attacks on Palmer's metal in gas making (Rec., p. 22).

In the Palmer apparatus coal is placed inside the retort 2 and heat is supplied to the outside of this retort. The problem presented to Palmer, therefore, is substantially the same as that presented in steam boilers and other apparatus where external heat is supplied either from gas or oil. There is nothing to indicate that any sulphur corrosion problem is present, but, on the contrary, Mr. Dixon has stated that even in oil cracking stills there is no sulphur corrosion problem presented with respect to the exterior of the cracking tubes or stills (Rec., p. 22). He has stated that to his knowledge there is no such exterior corrosion on cracking tubes (Rec., p. 35). From this it must be concluded that no problem of sulphur corrosion was presented to Palmer and since he makes no mention of any such problem, it is impossible to understand how anything disclosed in the Palmer patent could act as an anticipation of Black's invention.

He had no oxidation problem on the interior of his retort because, as Mr. Dixon has pointed out, a reducing atmosphere is present in the interior of Palmer's retort and this, of course, is antithetical to oxidation (Rec., p. 23). Furthermore, as Mr. Dixon has pointed out, even assuming that hydrogen sulfide were present in Palmer's apparatus, the same is operated at such a high temperature, namely, 1100°C . (page 2, line 40), that this hydrogen sulfide would not attack steel because at that high temperature the gas is so dry that the reaction with steel does not take place (Rec., p. 35). In making the foregoing assumption, we wish it to be plainly understood that we have been unable to find in Palmer any disclosure of the presence of hydrogen sulfides or of any sulphur compounds, but, as Mr. Dixon has stated, even if they were present, they would be ineffective as cor-

rosion agents because of the high temperatures necessary to be used in the gas manufacture by Palmer (Rec., p. 35).

In addition to all the above reasons why Palmer does not anticipate Black, we submit that the following is in itself complete evidence of his failure to anticipate. On page 3, line 1, Palmer states that his alloy corresponds substantially to "cast iron in tensile strength, conductivity and coefficient of expansion." Dixon has pointed out (Rec., p. 36) that any alloy that has no more tensile strength than cast iron would be unsuitable for a cracking coil. This, we submit, completely disqualifies Palmer as an anticipation of Black.

Lest the Court might be misled into believing that there was something common between Black's invention and the pipe shown in Fig. 1 of Palmer, we point out that this pipe 7 is used merely for the purpose of superheating steam and, therefore, could not by any stretch of the imagination be subjected to any sulphur corrosion problem such as that which baffled the oil industry for so many years.

The defendant argued below that Palmer's superheating coil 7 showed that Black's coil was old. The defendant's argument in its brief before the lower Court was the first time that this point has ever been advanced. The Examiner made no reference to it in his rejection, the question was not discussed before the Board of Appeals in the Patent Office and no mention was made of it by Mr. Hostetler in his argument before the lower Court. It appeared for the first time in defendant's brief. Therefore, it is not properly before this Court. What is most important is that the use of the same alloy for a steam superheating coil could not anticipate Black's claims.

Gillespie 1,306,690: The Gillespie patent discloses nothing more than a composite sheet metal having chromium alloy steel on the face or faces of it with a mild steel base. It is not denied by applicant that chromium

steel was known before the date of his invention and since a true alloy composition of chromium steel was known prior to Black's invention, we are unable to understand what possible significance the Gillespie patent has in this case. Mr. Dixon has shown the impossibility of making a 3-inch or 4-inch cracking tube out of it (Rec., p. 24) and obviously no one would select such a composite structure as that of Gillespie for the purpose of making tubes when true chromium alloy steels were well known at that time. Mr. Dixon also states that Gillespie makes reference only to corrosion problems dealing with acids, such as fruit juices and the like, and does not offer any suggestion with respect to sulphur corrosion (Rec., p. 23).

In its argument below defendant makes the broad statement that Gillespie's alloy is non-corrodible or resistant to corrosion broadly. This is beside the point, because Black's claims are limited to an alloy resistant to *sulphur corrosion*. Since there is absolutely nothing in Gillespie to indicate that his alloy is resistant to *sulphur corrosion*, he fails to anticipate the specific claims on appeal.

Kelley 1,365,499: As pointed out by Mr. Dixon, the Kelley patent discloses a coating formed by alloying the coating with base metal, the chromium being powdered and both the chromium and the base metal being heated to a sufficiently high temperature to bring about alloyage (Rec., p. 24). Kelley makes no reference to the use of his material as an oil cracking tube, but, on the contrary, makes a statement, beginning page 1, line 87, which, as pointed out by Mr. Dixon (Rec., p. 24), clearly disqualifies Kelley's metal for use as a cracking tube or for any other part of a cracking unit. As pointed out by Mr. Dixon, Kelley's chromium coating is sufficiently porous to permit hydrocarbon gas to pass through it and supply carbon to the coated base metal, as stated by Kelley, beginning at line 87 (Rec., p. 24). This coating would also permit passage therethrough of hydrogen sulfide, which,

in turn, would attack the base metal and destroy the same, thus weakening the tube wall, eventually resulting in rupture. It, therefore, clearly appears that Kelley not only fails to state that his metal is suitable for preventing sulphur corrosion, but his own statement clearly shows to those skilled in the metallurgical art, like Mr. Dixon, that his metal would actually be unsuitable for such use. There is another reason why Kelley's process could not be applied to cracking tubes and that is the practical difficulty of producing his chromium coating on the interior of tubes as small in diameter as 3 inches or 4 inches. Even if the coating could be applied, Mr. Dixon has pointed out that the cleaning operation would in all probability rupture the surface coating, thus rendering it ineffective (Rec., p. 25). From the foregoing it is, therefore, submitted that it would be wholly impossible to use the Kelley metal as protection against sulphur corrosion.

It is pointed out by Mr. Dixon that the Kelley metal does have certain commercial applications, but such applications have nothing to do with the oil cracking industry (Rec., p. 26).

Van Steenberg 1, 407,339: This patent deals with apparatus for cracking mineral oil to produce gasoline. On page 4, beginning line 7, reference is made to Fig. 5, which discloses a chromel tube 41a, through which oil is passed to the cracking chamber. The structure of Fig. 5 may be substituted for the superheater shown at the lower right hand corner of Fig. 1. In Fig. 1 the superheater is heated by oil or other suitable fuel. When the structure of Fig. 5 is substituted for the superheater of Fig. 1, the heat is supplied by electricity. Chromel is the same thing as the well known nichrome, which is an alloy consisting of 80% nickel and 20% chromium. Mr. Dixon has pointed out that the only disclosed reason for making the pipe 41a of chromel is to take advantage of its known electric resistance qualities and for no other reason (Rec., p. 27). The fact that oil flows through this pipe is merely incidental. This is well illustrated by the fact that when

the ordinary heating means are employed, the tube 41 of Fig. 1, so far as any disclosure is concerned, is of ordinary carbon steel. This fact is further emphasized by the arrangement shown in Fig. 1, where the oil leaving the coil 41 enters pipe 42 and from there is transmitted into the main cracking chamber shown partly in section in Fig. 1, all of the pipes of which, so far as the disclosure shows, are ordinary carbon steel or iron. There is not a word in the specification which even indicates that Van Steenbergh appreciated the existence of a sulphur corrosion problem. Bearing in mind the practice in the art as of 1920, when Van Steenbergh's application was filed, it is obvious that he did not appreciate the existence of such a problem and certainly he did not offer any solution thereof. How foolish it would be to provide a chromel tube, as at 41a, for the purpose of preventing sulphur corrosion while passing the oil from that tube into the steel tube 42 and from there into a steel chamber 1, where the bulk of the cracking takes place. Whatever sulphur corrosion problem would be present in the tube 41a, would likewise be present in the tube 42, as well as in all of the metal parts exposed in the chamber 1. Certainly if Van Steenbergh had had in mind the prevention of sulphur corrosion, he would have pointed out the necessity of making the pipe 42, as well as all the other exposed metal parts of the chamber 1, of chromium or some other material capable of resisting sulphur corrosion. His utter failure to mention the existence of the sulphur corrosion problem, coupled with the use of ordinary steel pipes and chambers in the cracking zone, shows overwhelmingly that he either failed to appreciate the existence of such a problem or that he knew no answer to it, or both.

The mere fact that Van Steenbergh uses chromel for the electric heater tubes 41a and passes oil through them, furnishes no information whatever to the art that chromel is the answer to the sulphur corrosion problem. As previously stated, chromel was used in 41a exclusively for

its well known electric resistance properties, and if any sulphur corrosion problem was presented in the pipe 41a, it was wholly unappreciated and, therefore, would not act as an anticipation. The chromel acts in Van Steenberg's superheater the same as the heating element in toasters, waffle irons, coffee percolators and other electrical utensils and was selected by Van Steenberg because of its known electrical resistance properties as manifested by its exclusive use in such household implements.

Quite aside from the fact that Van Steenberg failed to appreciate the existence of a sulphur corrosion problem, the composition which he discloses does not meet the claims and for many reasons is undesirable and unsuited for cracking oil. All of the appealed claims relate specifically to an alloy of iron and chromium (claims 13 and 15) or iron, chromium and nickel (claims 14 and 16). It would be utterly impossible for Van Steenberg to use as an electrical heating element an alloy of either *iron* and chromium or *iron*, chromium and nickel. The only possible alloy for his use would be one composed entirely of nickel and chromium and nothing more. The chromel or nichrome used by Van Steenberg was the first alloy usable as an electrical heating element brought to incandescence in the presence of oxygen without being destroyed. It is a direct result of that invention (which is fully set forth in the case of *General Electric Co. vs. Hoskins Company*, 224 Fed. 464, *supra*, page 30) that we are today able to use toasters and other electrically heated household implements. If Van Steenberg substituted either of applicant's iron alloys for the chromel alloy which he uses for his coil 41a, the coil would be destroyed upon the first attempt to use it. In addition to all of the other reasons above given as to why Van Steenberg does not meet the claims, it should also be noted that applicant's iron alloys could not be substituted for Van Steenberg's and neither could Van Steen-

bergh's chromel alloy be substituted for applicant's for the cracking of oil.

Despite the above, the defendant argued below that Van Steenbergh emphasizes the proposition that it is not invention to take advantage of the prior art knowledge of the desirable properties and advantages of chromium nickel *steel* tubes for cracking purposes. This argument is not supported by Van Steenbergh, but is absolutely contradicted by that patent.

Clearly Van Steenbergh does not disclose or suggest applicant's invention, and shows no appreciation of the problem facing the industry and solved by applicant. If Van Steenbergh's alloy has any utility in so far as the sulphur corrosion problem is concerned, the teaching of the patent demonstrates that it was unwitting, unrecognized and accidental.

It is well settled law that accidental or unappreciated use does not anticipate.

Eibel v. Paper Co., 261 U. S. 45, 66:

"It is contended on behalf of the defendant that whether Barrett and Horne perceived the advantage of speeding up the stock to an equality with the wire, yet the necessary effect of their devices was to achieve that result and therefore their machine anticipated Eibel. In the first place, we find no evidence that any pitch of the wire, used before Eibel, had brought about such a result as that sought by him, and in the second place if it had done so under unusual conditions, accidental results, not intended and not appreciated, do not constitute anticipation. *Tilghman v. Proctor*, 102 U. S. 707, 711; *Pittsburgh Reduction Co. v. Cowles Electric Co.*, 55 Fed. 301, 307; *Andrews v. Carman*, 13 Blatchf. 307, 323."

Wickelman v. Dick, 88 Fed. 264, 266, C. C. A. 2:

"Chance operation of a principle, unrecognized by anyone at the time and from which no information of its existence and no knowledge of the

method of its employment is derived by anyone, if proved to have occurred, will not be sufficient to defeat the claim of him who first discovers the principle; and, by putting it to practical and intelligent use, first makes it available to man."

United Verde Co. v. Pierce-Smith Co., 7 Fed. (2d) 13, 16, C. C. A. 3:

"But if it ever protected the basic lining (which was by no means proved) it was accidental. The patentees did not know it, or, knowing it, they did not tell it to the art. It is only in the light of what Smith afterward discovered, and did, that the disclosures of the Baggaley and Allen patent have any application to Smith's problem. But the important thing is that, if, in the light of Smith, the Baggaley and Allen method can be used to protect a basic lining, Baggaley and Allen * * * did not suggest even remotely the idea of Smith * * *

"In in this operation Heywood's workmen at anytime hit upon the amount and composition of the flux required by the Smith process and attained its result, it was purely accidental and was without profit to the art and without value as an anticipation."

In *Pittsburgh Reduction Co. v. Cowles*, 55 Fed. 301, 307, above cited in the Supreme Court, Judge TAFT said:

"But suppose it to be a fact that in DeVille's process alumina was dissolved in the bath from the anode, and that thereupon it was electrolyzed as in the Hall process, it was a mere accident, of which DeVille made no note, and which, therefore, we must reasonably infer he did not observe. Accidents of this character cannot be relied on as anticipations of a patented process when the inventor does not recognize the means by which the accidental result is accomplished, and does not thereafter commercially and purposely adopt such means as a process for reaching the result."

Walker on Patents, 6th Edition, Sec. 106:

"Novelty is not negatived by any prior accidental occurrence or production, the character and

function of which was not recognized until later than the date of the patented invention sought to be anticipated thereby. *Tilghman v. Proctor*, 102 U. S. 711, 1880; *Pittsburgh Reduction Co. v. Cowles Electric Co.*, 55 F. R. 307, 1893; *Chase v. Fillebrown*, 58 F. R. 377; 1893; *Wickelman v. A. B. Dick Co.*, 88 F. R. 266; 1898; *Tannage Patent Co. v. Donallan*, 93 F. R. 821, 1899; *Ajax Metal Co. v. Brady Brass Co.*, 155 F. R. 409, 1907; *Western Tube Co. v. Rainer*, 156 F. R. 49, 1907; *Hillard v. Fisher Book Typewriter Co.*, 159 F. R. 439, 1908; *Edison Electric Lighting Co. v. Novelty Incandescent Lamp Co.*, 167 F. R. 977, 1909; *Anthracite Separate Co. v. Pollock*, 175 F. R. 108, 1909; *Byerly v. Barber Asphalt Paving Co.*, 230 F. R. 995, 1916; *Toch v. Zibell Damp Resisting Paint Co.*, 233 F. R. 993, 1916; *United Verde Copper Co. v. Pierce-Smith Converter Co.*, 7 F. (2d) 13, 16 C. C. A., 3rd Cir.; *Carson v. Am. Smelting & R. Co.*, 11 F. (2d) 766, C. C. A., 9th Cir."

Metzger 1,422,878: Metzger deals with a process of making a surface alloyed metal for retorts. As Mr. Dixon states, this is a well known general method, consisting in the use of a gun through which a wire of selected composition is passed and subjected to an oxy-acetylene flame which melts the wire and blows the liquid metal against the surface of the base metal to be coated or alloyed (Rec., pp. 28-29). So far as this case is concerned, Metzger discloses nothing more than another method or process by which a surface alloy may be placed upon a metal base. He does not make the slightest suggestion of the existence of any sulphur corrosion problem, nor does he refer in any manner to the possible use of his metal in the oil cracking industry. Mr. Dixon has pointed out many reasons why a metal such as that produced by Metzger could not be used as a cracking tube (Rec., p. 29) and bases his statement upon some very intimate and extensive experience with the same process broadly disclosed in the Metzger patent. According to Mr. Dixon, the Texas Company, by which he is employed, spent up-

wards of \$10,000 trying to produce a coating on large tanks by the use of a process like that of Metzger (Rec., p. 29). It was found, despite this expenditure of time and money, that the Texas Company was unable to produce a single satisfactory coating by this method. Certainly if it was found impossible to produce a satisfactory coating on the large tank by such a process, it would be utterly useless to even attempt to place such a coating inside a 3-inch or 4-inch tube, such as that commonly used as cracking tubes.

Specifically, the success of such a process depends upon the formation of a metallurgical bond between the base metal and the coating metal. Mr. Dixon's experience was that even with lower melting point metals than chromium, this metallurgical bond was not realized and that with chromium it would be all the more difficult to secure (Rec., p. 29). Without such a metallurgical bond, Mr. Dixon stated that the metallic cleaners, which must be used to clean the cracking tubes, would rupture the surface coating, whereupon the sulphur compounds would attack the base metal (Rec., p. 29) and produce a situation even more hazardous than if steel or iron were used in the first place. Furthermore, coatings of this type are inherently rough and would afford a ready base for the deposit of carbon and coke and thus necessitate more frequent cleaning, thereby increasing the likelihood of rupturing the coating and rendering it ineffective. Since Metzger either did not appreciate the existence of a sulphur corrosion problem or, if so, realizing that his coating would be wholly ineffective as a solution of said problem, he can not constitute an anticipation of Black's invention and may, therefore, be disregarded as a reference.

Metzger is like Palmer in that he is dealing with retorts for making natural gas substitutes. Even if hydrogen sulfide were present in Metzger's apparatus, it would not attack even iron or steel for reasons pointed out in connection with Palmer. Certainly Metzger did

not face any such problem and has given no indication that anything that he has done or disclosed would effectively meet such a problem.

We submit that Mr. Dixon has shown conclusively that the Board of Appeals and the Court below were in error in the conclusion that Metzger discloses a use for his alloy analogous to that of Black. As a matter of fact, there is absolutely nothing in common between the two, nor is there anything in Metzger that even "squints" at Black's problem, or its solution. In fact there is no more disclosed in Metzger than applicant freely admits, namely, that prior to the date of his invention chromium steel alloys were known to exist. It is submitted, therefore, that the Court below was clearly in error in rejecting Black's claims on the misunderstanding that Black's problem and Metzger's problem were analogous.

The Law.

The question of invention is largely a matter of opinion because there is no known exact yardstick by which the presence or absence of invention can be determined. It is, therefore, proper that reference be made to prior cases somewhat similar to the case in question to determine what other courts have done with respect to the subject matter before them.

We discuss below a number of cases where the patents have been granted and where issued patents have been sustained which, in our best judgment, were not as great a contribution to the particular art or industry to which they relate as is the invention of Black, which is before this Court.

1. This Court held that it involved invention to substitute fused cement for soluble adhesive for holding together the layers of paper vessels, because a new and useful result was secured. *In Re Harbeck*, 39 App. D. C. 555; 191 O. G. 586.

2. The Court of Customs and Patent Appeals held *In Re Covey*, Patent Appeal, 3077 (63 Fed. 2d 982) that it was patentable to use anti-skidding crepe rubber composition on tires, although such rubber had been used on shoe soles. The properties of crepe rubber were known and claims were allowed on the basis that tire treads made of crepe rubber were superior to those made of ordinary rubber.

3. The United States Supreme Court held in *Smith vs. Goodyear Dental Vulcanite Co.* (93 U. S. 486) that invention was involved in substituting rubber for other materials in making dental plates. The properties of rubber were known before the substitution was made but the patent was sustained on the basis that the dental plate made of rubber was superior to plates made of other materials.

4. The Second Circuit Court of Appeals, in *Akme Flue v. Aluminite Co.* (27 Fed. 2d 736) reversed the lower Court and held Koehler patent 1,509,674 valid and infringed. The invention of that patent is (p. 736):

“* * * a process and an apparatus for getting rid of greasy soot from kitchen range ovens by passing the fumes from the oven through a flue having a filter mat of steel wool.”

The Court of Appeals stated (p. 736):

“To hold that there is any suggestion in Kling’s patent of what Koehler did, or that ‘the applicability of steel wool to the new use’ Koehler made of it would occur to any person of ordinary skill in the art seems to us unwarranted. The filtering of inorganic dust from combustible gases is a very different problem than the consuming of greasy soot carried by kitchen oven vapors.”

Again the Court said (pp. 737-8):

“The substitution of a known material has frequently been held to constitute invention.” (Cit-

ing many of the cases cited by us under this heading.)

The prior art in the above case was very much closer than any prior art in this case and the problems presented to Koehler were infinitely simpler than those presented to Black. Still the Court held the Koehler patent valid and infringed.

5. The First Circuit Court of Appeals held in *Forsyth v. Garlock et al.* (142 Fed. 461) that invention was involved in making a gasket for steam cylinders out of pliable metal and rubber sheets, although similar material had previously been used for other purposes. The lower Court was reversed on the ground that the use of this material as a gasket or for steam packing was patentable.

6. Another decision similar to *Forsyth v. Garlock, supra*, is *Warren Bros. v. City of Owosso* (166 Fed. 309), in which the Sixth Circuit Court of Appeals held that a wearing surface for pavements made up of mineral matter united by asphalt, or other plastic material, was patentable, although a very similar composition had been used as a waterproof lining for reservoirs.

7. A decision somewhat similar to the two preceding ones is that of the Second Circuit Court of Appeals in *Smokador Mfg. Co. v. Tubular Products Co.* (31 Fed. 2d 255), in which it was held that a patent for an ash stand with a glass waste-receiving receptacle was valid, although the prior art showed ash stands with a wood waste-receiving receptacle. The claims were not specifically limited to glass, but the Court construed them as being so limited and sustained the claims on the basis of substituting glass for wood. No new property of glass was present and there was nothing unexpected revealed. It was a plain case of substitution.

8. A very pertinent decision in connection with the appealed claims is that of the District Court of New

York in *Ludlum Steel Co. v. Terry* (37 Fed. 2d 153), in which that Court upheld a patent for a valve made of a certain alloy, although the patentee had already been granted a patent for the alloy itself.

9. Another pertinent decision is that of the Third Circuit Court of Appeals in *Allen Filter Co. v. Star Metal* (40 Fed. 2d 252), in which that Court sustained a patent for a water cooler having a coil of resilient metal, although water coolers having coils of metal were old and it was known that the metal which the patentee substituted for other metals in making the coil was resilient. The Court said:

“it is equally well settled, however, that there may be invention in selecting a particular material for a particular purpose, although other materials of the same class have been used before for the same purpose, and even though a patent has been previously granted for the use of the whole class” (p. 254).

10. In *Single Tube Co. v. Continental Rubber Works* (174 Fed. 50), the Circuit Court (Pennsylvania) sustained a patent for tires made up of an inner rubber tube, an intervening fabric and an outer rubber cover vulcanized together, although the same vulcanized product had been used for years in making hose pipes and gaskets. A new use of an old material was held patentable in that case.

11. The Second Circuit Court of Appeals held in *United Shoe Machinery Corporation v. E. H. Ferree Co.* (64 Fed. 2d 101) that invention was involved in substituting an aluminum alloy arm for a cast iron arm in a clicking machine for manufacturing shoe uppers, on the ground that the light aluminum arm possessed advantages over the old heavy, cast iron arm which performed exactly the same functions. No unexpected result was obtained and no unknown property or quality of the material was discovered in its new use. The patent was

sustained because of the advantages of having the workmen become less tired and the bringing of the center of gravity closer to the spindle, although the quality of the work performed was no better but merely "as good". The Court said (p. 103) that by the use of one material instead of the other, a

"* * * useful result or increase of efficiency and decided saving in the operation is clearly obtained. *Hicks v. Kelsey*, 18 Wall, 670, 673, 21 L. Ed. 852. In *George Frost Co. v. Cohn*, 119 F. 505, 507, this court held it to be invention where there was a substitution of rubber for metal in a garter button, and we stated that the feature of novelty resides only in the material of which the button is composed. There was no claim of new qualities in the rubber, and properties of rubber were known to every one at the time. Against the argument that a mere substitution of materials was a perfectly obvious thing to do, we said: 'It was also common knowledge that it has the property of clinging, and its use on shoe, stairway steps, and for mats and floor coverings are familiar instances illustrating its adaptability to prevent slipping. It has also been used for buttons in order that its elasticity would permit the button to yield easily to sudden pressure, and yet not abrade the fabric of the buttonhole, as in the instance of the collar stud of the Allen patent. * * * When the substitution has accomplished a result which those skilled in the art had long and vainly sought to effect, the evidence that it involved something beyond the skill of the calling is so persuasive that it generally resolves the inquiry in favor of patentable novelty.'"

12. The First Circuit Court of Appeals held in *Fitchburg Duck Mills vs. Barrell* (214 Fed. 777) that the use of a double ply fabric as a drier felt in paper mills was patentable, although this fabric was previously known and used for other purposes. This patent was sustained very largely on the ground that the life of the drier felt was increased and the damage to the paper largely re-

moved (page 779, near the bottom). The increase in the life of the drier felt was less than 100%, whereas the increase in the life of Black's tubes is at least 500%.

13. The Seventh Circuit Court of Appeals in *General Electric Co. vs. Hoskins Mfg. Co.* (224 Fed. 464) sustained a patent for an electric-resistance heating element that was made of a metal alloy, although the alloy itself was known. This was the well-known nichrome metal containing 80% nickel and 20% chromium.

14. The Third Circuit Court of Appeals in *Yablick vs. Protecto* (21 Fed. 2d 885) sustained a patent for a gas mask in which copper sulphate was substituted for other substances as the gas absorbent, although it was known before the substitution was made that copper sulphate had gas absorption properties. The Court said (p. 887):

“* * * ‘It is also the law, as exceptions to this general rule, that, if the substitution involved a new mode of construction, or if it developed new properties and uses of the article made, or where it produces a new mode of operation, or results in a new function, or when it is the first practical success in the art in which the substitution is made, or where the practice shows its superiority to consist not only in greater cheapness and greater utility, but also in more efficient action, it may amount to invention.’

“The facts of the case at bar bring it within the principles of the law announced in the above case. The selection of one material, and that by a process of exclusion even where the inventor stumbled on the discovery, has been held to constitute invention. *Naylor v. Alsop Process Co.* (C.C.A.) 168 F. 911, 919; *Van Heusen Products v. Earl & Wilson* (D.C.) 300 F. 922, 929; *International Cork Co. v. New Process Cork Co.* (C.C.A.) 6 F. (2d) 420. In the case of the *Toledo Rex Spray Co. v. California Spray Chemical Co.* (C.C.A. 6) 268 F. 201, the substitution of arsenic acid for sulphuric acid in making arsenate of lead was held to

constitute invention. The court said that during the forty years of making arsenate of lead it had not occurred to any one to substitute arsenic acid for sulphuric acid. The substitution proved a great commercial success."

15. In a recent decision, *Acme Card System Co. v. Remington Rand Business Service* (3 Fed. Supp. 254), the District Court (Md.) sustained a patent for flexible index strips over defendant's contention that there was merely the substitution of superior for inferior materials and summarized what the Supreme Court had said, as follows (p. 256):

"Merely substituting superior for inferior materials may not be patentable invention, although the substitution may be of materials that are both new and useful in high degree; but if the substitution involves a new mode of construction, or if it develops new properties and uses in the art, or produces a new mode of operation, or results in a new function, or if it represents the first practical success in the art in which the substitution is made, or where there is superiority in the substitution by reason of greater cheapness and utility and also in more efficient action or functioning, that may amount to invention."

16. The District Court (So. Dist. of N. Y.) decided in *P. R. Mallory & Co. v. Automotive Mfrs' Outlet* (45 Fed. 2d 810) that the substitution of tungsten for other metals in electrical make-and-break contacts involved invention, although it was known that tungsten was a conductor of electricity.

17. The Second Circuit Court of Appeals held in *George Frost Co. v. Samstag* (180 Fed. 739), that the substitution of a rubber button for a metal button in a hose supporter involved patentable invention.

18. The Second Circuit Court of Appeals upheld the Parks patent in *Danbury & Bethel Fur Co. vs. American*

Hatters (54 Fed. 2d 344) for carroting fur, and said (p. 346):

“The appellant argues that the patent No. 1,507,891 is invalid because the composition of matter is an unpatentable discovery. The discovery of a novel use of an old substance in a new composition, whereby there is attained a new and unobvious result, has long been held to be patentable. In *General Electric Co. v. Hoskins*, 224 F. 464 (C. C. A. 7), it was argued that the nichrome wire, of which are made the resistance wires for electric toasters, flatirons and the like, was not patentable because the alloy of the wire was old at the time of the invention there in question, and it was old for the purpose of electrical resistance. But the court held that was insufficient to invalidate the patent. Copper sulphate used in the gas mask to absorb ammonia was broadly patentable, although the same substance had been used for the same purpose before. *Yablick v. Protecto Corp.*, 21 F. (2d) 885 (C. C. A. 3). See: *Corona v. Dovan*, 275 U. S. 358, 48 S. Ct. 380, 72 L. Ed. 610; *Ansonia Co. v. Electrical Supply Co.*, 144 U. S. 11, 12 S. Ct. 601, 36 L. Ed. 327; *Internatl. Cork Co. v. New Process Co.*, 6 F. (2d) 420 (C. C. A. 2).”

19. The Third Circuit Court of Appeals upheld a patent for a vulcanizing package in *Low v. McMaster* (266 Fed. 518), saying (p. 519):

“On this subject it is the law, that merely to substitute superior for inferior materials, in making one or more or all of the parts of a machine or manufacture, is not invention, although the substitution may be of materials that are both new and useful in high degree. It is also that the law, as exceptions to this general rule, that if the substitution involved a new mode of construction; or if it developed new properties and uses of the article made; or where it produces a new mode of operation, or results in a new function; or when it is the first practical success in the art in which the substitution is made; or where the practice shows its superiority to consist not only in greater

cheapness and greater utility, but also in more efficient action, it may amount to invention. *Smith v. Goodyear Dental Vulcanite Co.*, 93 U. S. 486, 496, 23 L. Ed. 952; *Celluloid Mfg. Co. v. Crane Chemical Co. (C. C.)* 36 Fed. 110; *Potts v. Craeger*, 155 U. S. 597, 608, 15 Sup. Ct. 194, 39 L. Ed. 75; *Walker on Patents*, Paragraphs 28, 29, 36."

20. The Sixth Circuit Court of Appeals sustained the Walker patent No. 1,234,984 for a road surfacing device, in *Lakewood Engineering Co. v. Walker* (23 Fed. 2d 623), affirming the District Judge, holding that there was invention present in the conception that old material could be employed for the new use, coupled with the rather obvious mechanical changes which were necessary to apply the thought.

This Court is no doubt familiar with many of the foregoing cases and also the large number of additional cases referred to by the courts in the above-quoted cases.

If the measure of invention found in the above-noted cases is applied to the present case, it is difficult to understand how the presence of invention could be doubted.

We are unable to understand how the lower tribunals could hold Black's claims unpatentable in view of the many admitted important advantages pointed out by Mr. Dixon.

Conclusions

The testimony of Mr. Dixon showing the existence for several years of a major problem in the oil cracking industry; a study of the patents cited by the Patent Office showing no conception or appreciation on the part of those patentees of even the existence of such a problem; the large extent to which the invention has displaced the previous universal use of steel cracking tubes and the large number of advantages possessed by the chromium steel alloy cracking tubes, all force one to the conclusion that Black met and solved a real problem in one of the

country's largest industries in a manner so practical as to substantially displace the cracking tube which was accepted by the industry at that time as the standard and, therefore, best of all those known as of that date.

A review of only a few of the cases dealing with the general question of law involved here shows that the Courts throughout the country have heretofore found invention to exist under circumstances similar to these where the resultant advantages were very much less. This again forces one to the conclusion that invention must have been involved in what Black has done.

In view of all the foregoing, it is respectfully submitted that in the light of the convincing evidence before this Court, the Court below should be reversed and a patent granted on Black's meritorious invention.

Respectfully submitted,

SEMMES AND SEMMES,
Solicitors for Plaintiff-Appellant.

NEWTON A. BURGESS,
Of Counsel.

August 28, 1935.

UNITED STATES
COURT OF APPEALS FOR
DISTRICT OF COLUMBIA

SEP 14 1935
Franklin D. Roosevelt

No. 6492

In the United States Court of Appeals
for the District of Columbia

OCTOBER TERM, 1935

GASOLINE PRODUCTS COMPANY, INC., APPELLANT

v.

CONWAY P. COE, COMMISSIONER OF PATENTS,
APPELLEE

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF
COLUMBIA

BRIEF FOR THE COMMISSIONER OF PATENTS

R. F. WHITEHEAD,
Solicitor United States Patent Office.

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*APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF
COLUMBIA*

BRIEF FOR THE COMMISSIONER OF PATENTS

This is an appeal by the Gasoline Products Company, Inc., plaintiff in the Court below, from a decree of the Supreme Court of the District of Columbia dismissing an appeal brought under the provisions of Section 4915 R. S. (35 U. S. C. A. 63, as amended) to enforce the issuance of a patent on an application of plaintiff's assignor, John C. Black.

The alleged invention relates to the coils of an apparatus for cracking petroleum oils, and particularly to the making of such coils of an iron

and chromium alloy, or an iron, chromium, and nickel alloy, which will be substantially resistant to the action of sulphur.

The involved claims are four in number and read as follows:

13. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron and chromium alloy, said chromium in the alloy being in such proportions as to substantially prevent the corrosive action of sulphur.

14. In an apparatus for cracking petroleum oils for the production of lower boiling hydrocarbon oils, a metallic cracking coil substantially resistant to the action of sulphur, said metallic coil being composed of an iron chromium nickel alloy, said alloy being in such constituent proportions as to substantially prevent the corrosive action of sulphur.

15. An apparatus for cracking hydrocarbons comprising a furnace, a cracking coil positioned within said furnace, said coil being formed of material comprising an alloy of iron and chromium substantially resistant to the corrosive action of sulphur and means in said furnace for supplying products of combustion thereto.

16. An apparatus for cracking hydrocarbons comprising a furnace, a plurality of

tubes in said furnace through which the oil to be cracked is passed under pressure, said tubes being formed of an alloy of iron chromium and nickel, substantially resistant to the action of sulphur under the conditions of cracking, and means for passing hot products of combustion over said tubes to crack the oil therein.

A number of patents were cited by the Patent Office and considered by the Court below. Of these, the patent to Black, No. 1426813 was cited as showing an apparatus substantially the same as the apparatus disclosed in the involved application, in which the corresponding pipes are not made of a chromium alloy. The other patents were cited to show that it was well known that chromium steel is resistant to corrosion and that therefore there was no invention in substituting pipes made of that material for the pipes of the Black patent.

It is well settled that a mere change of material of which an article or an apparatus is made is not invention. (*Potts v. Creager*, 155 U. S. 597, 1895 C. D. 143.) It is submitted that this is certainly true in a case where the material is selected because of its known characteristics which make it particularly adapted for the new use.

This broad proposition is not attacked by appellant but it is argued that the facts of this case are such as to make it an exception to that general rule and to bring it within that class of decisions which hold that because of the special facts in the case a

patent involving a mere change of material was valid.

It is argued that while the patents cited by the Patent Office do show the use of chromium steel and show that such steel is resistant to corrosion, there is nothing in the record to show that it would be resistant to corrosion brought about by the presence of sulphur and that the substitution was invention on Black's part since he discovered that the corrosion of these cracking coils was brought about by the presence of sulphur in the oil and that such corrosion would be avoided if a chromium alloy tube is used.

The position of the Patent Office, and obviously the position taken by the lower court, was that the patents cited taught that the chromium alloy was resistant to corrosion and that that necessarily included corrosion brought about by the presence of sulphur in the material which was brought into contact with the metal. In fact, the record of the application shows that the examiner stated it was a matter of common knowledge that such tubes were resistant to sulphur corrosion.

It is true that none of the patents cited shows a coil for an oil-cracking apparatus, nor does any one of them specifically state that the material is resistant to sulphur corrosion, but the apparatus shown in certain of these patents, for instance, the Metzger patent, 1422878, referred to by the Board of Appeals, was used under conditions where sulphur

was present in the gases brought into contact with the material.

The question of whether invention exists where there has been a change of material has often been considered by the courts and a number of decisions on that question are referred to in *Columbia Metal Box Co. v. Halpher*, 200 Fed. Rep. 912, where it was held that there was no invention in making a junction box for use in electric wiring of sheet metal where similar boxes had been made of cast iron. The Court stated that the new method of manufacture was such that would occur to the ordinary mechanic.

It is submitted that the art taught broadly that chromium steel would resist corrosion and therefore when it was found that the pipes in a cracking apparatus corroded during the carrying out of the cracking process, it was not invention to substitute for the steel pipe previously used a similar pipe made of chromium alloy.

It is enlightening to know that the applicant, himself, when he filed his application did not think that he had made any such invention as is now claimed because, while in his application (R. p. 40) he stated that in order to overcome the corrosion of the pipes he preferred to use an alloy of steel, such as nickel steel, or chromium nickel steel, no claim was made broadly to the use of such a steel.

The claims appearing on pages 45 and 46 of the Record were all directed to a particular form of

the coil, or the particular way in which the coil was made up, and only three of the claims, 4, 6, and 7, made any reference to the material being sulphur resisting, and those all specify the particular manner in which the coil was made. In other words, the claims were all limited to a particular kind of a coil even though in three of them this coil was stated to be sulphur resistant. The application was allowed with certain of these claims and the present claims were not presented until the application was forfeited and renewed.

It is submitted that applicant's original position was correct and that the claims presented in the renewed application, which were the claims here under consideration, were not patentable, and that the Bill in Equity was properly dismissed, and the decree of the Court below should be affirmed.

R. F. WHITEHEAD,
Solicitor for the Patent Office,
Attorney for Appellee.

SEPTEMBER 3, 1935.

IN THE

United States Court of Appeals
FOR THE DISTRICT OF COLUMBIA.

In Equity No. 6492.

GASOLINE PRODUCTS COMPANY, INC.,
Plaintiff-Appellant,
vs.

CONWAY P. COE, Commissioner of Patents,
Defendant-Appellee.

REPLY BRIEF FOR PLAINTIFF-APPELLANT.

SEMMES AND SEMMES,
Solicitors for Plaintiff-Appellant.

NEWTON A. BURGESS,
Of Counsel.

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REPLY BRIEF FOR PLAINTIFF-APPELLANT.

Upon motion made in open court, permission was kindly given for plaintiff-appellant to file a reply brief.

Throughout the brief for the Commissioner, statements are found to the effect that it was well known that chromium steel was resistant to corrosion. This argument is beside the point because all the claims on appeal refer specifically to a cracking coil or tube resistant to the corrosive action of sulphur. There are many alloys and metals that are resistant to corrosion generally but may not be resistant to sulphur corrosion under the temperature and pressure conditions of cracking. The mere fact that chromium alloys are resistant to corrosion generally, has no bearing upon the present question.

Dixon points out (Rec., p. 33) that while all petroleum oil contains some sulphur, there would be very little corroding effect without heat or pressure, and that the corrosive effect of the sulphur is increased by heat and pressure. The discovery and appreciation of the fact

that it was sulphur under conditions of heat and pressure in a cracking coil that caused the corrosion, is a large element of the present invention. No one had appreciated that fact prior to Black and the mere knowledge that chromium steel alloys were corrosion resistant generally, in no way negatives an invention which involves the discovery of the source of cracking tube trouble and the application of the remedy.

The Commissioner's brief states (Br., p. 4) that:

"In fact, the record of the application shows that the examiner stated it was a matter of common knowledge that such tubes were resistant to sulphur corrosion."

Obviously the Examiner's statement that such was common knowledge is no proof that it is a fact. Furthermore, Dixon repeatedly stated in the record that it was not known prior to Black.

The Commissioner admits (Br., p. 4) that "none of the patents cited shows a coil for an oil-cracking apparatus, nor does any one of them specifically state that the material is resistant to sulphur corrosion, * * *."

Reliance is placed principally upon the patent to Metzger and it is stated (Br., p. 4) that the Metzger composition "was used under conditions where sulphur was present in the gases brought into contact with the material."

We have discussed the Metzger patent at length in our main brief and also the similar patent to Palmer, and have shown that his surface coating is unsuitable for cracking tubes and that there is nothing disclosed in Metzger to indicate that he appreciated the presence of sulphur corrosion or even encountered such a problem. There is no basis whatever for the Commissioner's statement; there is no testimony to support it, but, on the contrary, it is specifically denied by Dixon.

The Commissioner has referred to *Potts v. Creager*, 155 U. S. 597 (Br., p. 3). There it was held that a new

application of an old device, so nearly analogous to the former use that its applicability would occur to a person of ordinary mechanical skill, is a mere double use and, therefore, not patentable.

It appears from this record that prior to Black, there never was a cracking coil made from chromium steel or chromium nickel steel. Therefore, a cracking coil of this kind is novel. It makes no difference as to such novelty that chromium steel and chromium steel alloys in other forms were known at that time. The claims on appeal all call for a cracking coil of this alloy and, moreover, one that is resistant to sulphur corrosion. There can be no dispute, therefore, that the coil of the claims is novel.

The Supreme Court also held in *Potts v. Creager* that if the old and new uses were not analogous and especially if the new use produced a new and unexpected result, it may involve invention. There can be no doubt that the use by Black of his novel cracking coil produced many useful and beneficial results, which were unforeseen, as were enumerated by Dixon (Rec., pp. 20-21).

The Commissioner's statement (Br., p. 3) that appellant argues that the facts of this case are such as to make it an exception to the general rule of *Potts v. Creager*, is erroneous. That decision set forth two fundamental rules, one where there was no invention and the other where invention was present. The present case comes under the second rule because it complies with all of the requirements of that rule.

The Commissioner has also referred to *Columbia v. Halpher*, 220 Fed. 912 (Br., p. 5). An examination of this case shows that it was entirely different from the present case. The Court makes it very plain that if there is a mere change of material without any unforeseen advantages, no invention is involved; but if new and unexpected results are secured, it states that invention may be present. In fact the Court refers to many of the cases cited in our main brief to show that under certain circumstances invention may be involved in a selection of ma-

terials. There is nothing in the *Columbia* case contrary to the decisions cited in our main brief, but, on the contrary, both that case and *Potts v. Creager* correctly state the law, which we are invoking in this case. They, therefore, support our argument of invention instead of the contrary.

The Commissioner argues (Br., p. 5) that chromium steel was known to resist corrosion and that when it was found that cracking tubes corroded, it was not invention to substitute chromium steel tubes to overcome such corrosion. This is a fallacious argument. It was known that copper, brass, nickel and many other metals and alloys were corrosion resistant. If the Commissioner's argument were sound, a tube of any of these materials might well have been used instead of chromium steel tubes. It did not at all follow that because there was corrosion in the old steel tubes, this would be cured by utilizing chromium steel tubes. It was first necessary to find the source of the corrosion, and then to find a suitable material that could be made into a tube suitable for cracking oil under vigorous temperature and pressure conditions, and which would also resist sulphur corrosion.

As a matter of fact the record shows (Rec., pp. 18-19) that in 1923-4 the general attitude of the oil industry toward corrosion in cracking tube equipment was that it was due to acid constituents in the oil. The Texas Company investigated the cause of corrosion and Mr. Lauer made a report in 1921 definitely stating that the corrosion around cracking units was due to acids. Accordingly, the Texas Company used metals that were acid resisting. It was not until February of 1925 that the Texas Company first installed chromium alloy cracking coils. This was after they had heard through Dixon of Black's invention disclosed in this application.

At the bottom of page 5 and top of page 6, the Commissioner advances an argument that is at least unique. Just what there could be in this argument to strengthen

the position of the Patent Office, is not apparent. It is one of the commonest practices in the Patent Office for inventors to insert new claims at any time during the pendency of their applications, provided they are based upon the original disclosure. The Commissioner admits the original disclosure but argues that since the claims were not originally presented in the form now on appeal, it proves that the present claims are not patentable. The Commissioner goes even farther and admits that three of the original claims did refer to the material being sulphur resistant. Since there is no question as to the original disclosure of the appealed claims, we are unable to understand how the Commissioner can successfully advance the argument that the claims are unpatentable because not originally filed in the form now on appeal. This is not only a new argument, presented for the first time in the Commissioner's brief, but we submit that it is an unsound argument that merits no consideration.

It is respectfully submitted that Black's claims should be allowed and a patent granted thereon.

Respectfully submitted,

SEMMES AND SEMMES,
Solicitors for Plaintiff-Appellant.

NEWTON A. BURGESS,
Of Counsel.

September 23, 1935.